CLUSTER ORGANIZATION, SUBJECTIVE ORGANIZATION, AND RECALL WITH TRAINABLE MENTALLY HANDICAPPED ADOLESCENTS

BY

ALICE TESCH

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For Beatrice and Bernard Tesch

Your belief, love, and support continues to
be a guiding force in your daughter's life.
I love you both.

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CLUSTER ORGANIZATION, SUBJECTIVE ORGANIZATION, AND RECALL WITH TRAINABLE MENTALLY HANDICAPPED ADOLESCENTS

By

Alice Tesch

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Chairman: Stuart E. Schwartz
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The purpose of this study was to examine the effects of types of items and rehearsal on organization and recall of a bimodal (visual and auditory) input task with trainable mentally handicapped (TMH) adolescents. The independent variables were types of items (related and unrelated pictures) and amount of rehearsal (five random trials). Thirty TMH students, ages 15 to 21 years, participated in the study.

A counterbalanced repeated measures design was used for the presentation of two slide-tape programs. Each consisted of related items (four pictures in each category of animals, transportation, and body parts) and 12 unrelated items. Individually, the subjects in Group 1 viewed the related items presentation first and after a one-week interval were shown the unrelated items. In Group 2, the subjects were shown the unrelated items first and after a one-week interval viewed the related items. The 12 items were presented at four-second intervals over five random trials. After each trial, the subjects were given up to two minutes to verbally recall the items and the researcher recorded their responses.

Recall and cluster and subjective organization were the dependent variables. Dependent t-tests were used to analyze the recall and organization data. The relationships between recall and type of organization were investigated using Pearson product-moment correlations. Cluster and subjective organization scores were calculated using Bousfield and Bousfield's Deviation Measure and Gorfein, Blair, and Rowland's (E) Measure, respectively.

The statistical analysis indicated no significant differences between recall scores on related and unrelated items. Significant differences were found on the number of items recalled over trials for both related and unrelated items. Obtained and chance cluster and subjective organization scores with related items were significantly different. No significant differences were found between obtained and chance subjective organization scores with unrelated items. Significant correlations were found between type of organization and number of items recalled with related and unrelated items.

Based on this research, teaching strategies and materials have been suggested which may facilitate improvement of recall and organization strategies with TMH students. Suggestions for further research were also presented.

CHAPTER I

INTRODUCTION

How do individuals learn? For over a century, this question has been the foundation for debate, postulation, speculation, and study by behavioral, social science, and educational researchers. Researchers continue to be concerned with the acquisition and transformation of knowledge represented in learning theory.

Early philosophers and theorists have given justification to the relationship between learning and memory. The ability to remember or effectively learn and use processes of memory is of primary importance for livelihood and survival (Adams, 1980). To understand research in the area of memory it is advantageous to examine the theoretical foundations of learning theory. Three branches of learning theory, including Associationism, Darwinism, and Gestalt Psychology, are presented in a brief historical perspective.

Learning Theory: A Brief Historical Perspective

Historically, learning theory has been multifaceted. Research investigating learning has been based on a variety of theories. Concern about the learning process and transformation of knowledge can be traced back through the centuries. The early knowledge base represented in the works of Aristotle and Plato laid the foundation for the development of three major areas of learning theory, including Associationism, Darwinism, and Gestalt Psychology.

Associationism Theory

Associationism was based on the principles presented by Aristotle and Plato and maintained that thoughts and images could be linked or associated with each other in the mind. Thoughts and images were believed to be the mental process relating events and experiences in memory. The relationships or associations of experiences set the memory process in motion enabling learning to occur (Adams, 1980).

Associationism philosophy was built on the belief that knowledge was learned through experience. The mind, specifically the memory, was considered a blank tablet. As events were experienced and associated through the five senses, the mind (i.e., memory), was structured. The mind received and recorded information but contributed no relationships of its own. Mental organization was determined by organization of related experiences. Hobbes (1588-1679), Locke (1632-1704), and Hartley (1705-1757) contributed to Associationism learning theory (Adams, 1980).

Ebbinghaus (1850-1909) and Pavlov (1849-1936) went beyond the theoretical works of Associationism (Adams, 1980). Through experimental study of practice time and recall, Ebbinghaus investigated memory based on theories of association. Pavlov also took an experimental approach concentrating on the association of stimuli and memory and how this relationship caused learning to take place. Pavlov investigated the stimulus-memory relationship, exemplified by teaching a dog to salivate at the sound of a bell which has been associated with food.

Darwinism Theory

Darwin (1809-1882) led the study of learning theory in a second direction (Adams, 1980). His basic premise, the importance of living species learning to adapt to the environment for survival, was called "survival of the fittest." Darwin's second premise of evolution implied a continuity between lower forms of life and humans. These two basic premises paved the way for studies of animal learning based on the belief that the results were applicable to learning in humans.

Gestalt Psychology Theory

Gestalt psychologists explored learning theory in a third direction. Gestalt philosophy was built on the belief that experiences could not be solely explained in terms of the synthesis of small, discrete units of information as advanced by early learning theorists. The major premise of Gestalt Psychology was that a given experience was greater than the sum of its parts (Adams, 1980).

The influence of Gestalt psychology in learning research was exemplified in Bartlett's (1932) study of memory. Memory was considered to be a reconstruction of past learning based on the existing attitudes and cognitions of the individual. Bartlett (1932) went beyond the simpler memory investigations of Ebbinghaus, using the premise that experience was greater than the isolated episodes.

According to Gestalt theorists, the mind was more than the blank slate as proposed in earlier learning theory. The mind was believed to process information perceived by an individual.

These three learning theories formed a foundation for contemporary theories of memory. Information processing components became important to the understanding of memory. Four major memory processing models have been developed to study memory, continuing the search to answer the question, "How do individuals learn?"

Memory Processing Models

Four models have had major impact on the study of information processing and memory and were developed by Broadbent (1958), Atkinson and Shiffrin (1968), Ellis (1970), and Spitz (1973). The four models depicted the various states of information memory processing.

Filter Theory

Broadbent (1958) developed a model which depicted the process of information as an individual performed a task. According to the model, information was stored briefly in a sensory component of the memory system before certain information was selected to be processed in memory. Information not processed was thought to be "filtered out" (i.e., not processed beyond the sensory system).

Information-Processing Model

An emphasis on the flow and transformation of information, based on the Filter Theory, was advanced by Atkinson and Shiffrin (1968). The Atkinson and Shiffrin model consisted of input, a three-process memory component, and output. The information received by an individual was input, and was then processed by the memory component. Retrieval of information was considered output.

The three types of memory, including sensory memory (i.e., Broadbent's theory), short-term memory, and long-term memory, were important when considering how an individual processed information. Information was gathered through the five senses. The information was filtered briefly through sensory memory and then entered a limited storage capacity area, short-term memory. Next, information was considered for long term storage (i.e., long-term memory).

Multiprocess Memory Model

The multiprocess memory model, developed by Ellis (1970), was based on the theoretical memory processing model developed by Atkinson and Shiffrin (1968). The Ellis model contained input as did Atkinson and Shiffrin's information processing model. However, the multiprocess model added the rehearsal strategy component and modified the three memory systems. Rehearsal strategies denoted the practice of information recall as immediate or delayed, silent or overt, deliberate or voluntary.

The three systems of memory included primary memory, secondary memory, and tertiary memory. Primary memory was the first, brief memory component used by an individual and was comparable to sensory memory in the Atkinson and Shiffrin model. Secondary memory and tertiary memory were the same as short-term memory and long-term memory respectively.

Spitz Memory Model

Spitz (1973) used major constructs from the Atkinson and Shiffrin (1968) model and formulated an idealized memory system. The basic processing components of this model included input, storage, and retrieval. Information came in as input, was stored in memory, and then was retrieved. The storage component consisted of short-term memory and long-term memory.

Memory Processing Components

The theoretical memory processing system, as presented by Spitz (1973), included three major components. Learning required the total memory process of input, storage, and output. These processing components have been briefly introduced in this section and are further discussed in Chapter II.

Input Component

The input component enabled information to enter the memory system and consisted of three stages. First, input began with a presentation of a stimulus (Spitz, 1973). Second, selective attention was used to focus attention on a subset of the environment at the expense of other stimuli. Third, the stimuli were encoded. Encoding referred to arranging information for storage in the memory system (Ellis, 1978).

Storage Component

Storage held information in the memory system (Ellis, 1978). In many ways storage was the core of the conceptualization of memory. The storage stage of the processing sequence was responsible for the maintenance of encoded information over time (Ellis, Bennett, Daniels, & Rickert, 1979).

Major memory theorists divided the storage unit of the memory system into different levels of memory. The levels of memory were differentiated by the amount of time encoded information was stored. Research in sensory information storage has been measured in milliseconds (Eriksen & Collins, 1968; Sperling, 1963). Short-term memory was considered a slightly more durable storage stage and was measured in units of seconds and minutes. Hours, days, and years have been used to measure long-term memory.

Short-term memory. Two major processes of short-term memory were labeled rehearsal and organization. A critical factor determining whether information would be retained or lost in short-term memory was the extent to which the information could be actively attended and rehearsed (Ellis et al., 1979; Peterson & Peterson, 1959). Miller (1956) introduced organization to rehearsal, which was important because the capacity of short-term memory was limited. For individuals to efficiently use short-term memory, information was organized into units known as chunks.

Long-term memory. Long-term memory was recognized by its extreme durability and was labeled permanent memory (Ellis, 1963). Hours, days, years, or decades were used to measure long-term memory. Long-term memory was characterized as a highly organized storage system capable of retaining essentially unlimited amounts of information for an indefinite period of time (Ellis et al., 1979).

Output Component

Information may have been stored in memory but this was not a guarantee that the information could be accessed or retrieved (Ellis, 1978). Output referred to the process of accessing or getting at stored information (Ellis, 1978; Spitz, 1973). Recall and organization were two concepts considered important to the output component of the memory processing model.

Recall in Output

Recall was a process used to measure memory by studying the retrieval or output of information. Recall demonstrated the occurrence of a learning process when an individual produced a response (Ellis, 1978).

A distinction has been made between two types of recall. Free recall was the process of producing a response of learned items in any particular order. The emphasis of free recall was the simple availability of responses, without any cues to assist the individual in recalling information. In contrast, aided recall provided the individual with some type of stimulus to cue the information to be recalled (Ellis, 1978).

Organization in Output

Organization was considered an overriding, integral component of the memory process. Organization played an important role in the different memory processing components previously discussed. During output, organization abilities can be measured by using free recall. The items in a free recall task can be recalled in any order allowing researchers to investigate how individuals organize recalled information. The organization process has been of major interest to researchers because organizational strategies aid individuals in remembering information. Therefore, organization was a key element when investigating how individuals learn. Two levels of organization, primary organization and secondary organization, have been suggested by Tulving (1968).

Primary organization. Primary organization describes factors that are independent of an individual's prior familiarity with presented information. The recency effect, which is an individual's tendency to recall the last item first (i.e., the most recently presented item) is an example of a type of primary organization.

Secondary organization. Secondary organization describes an individual's ability to recall information based on characteristics of the presented information. Information can be recalled on the basis of common features of form or meaning when no such grouping has been made during the presentation of information. Secondary organization can be subdivided into cluster organization and subjective organization.

Cluster organization. Cluster organization and subjective organization are two types of organization strategies that can be used in tasks which can be measured by free recall. Cluster organization as part of free recall refers to output being governed by relationships among items (Ellis et al., 1979). Cluster organization can be either associative or categorical. Associative clustering occurs when associatively related items or words, such as hot and sun or sky and blue, are randomly presented and recalled consecutively. In categorical clustering, conceptual relationships of items on a list, such as carrot and lettuce or car and truck, may determine the recall order of randomly presented items.

Subjective organization. Tulving (1962) identified subjective organization. Subjective organization is a process by which individuals impose their own organizational strategies to aid recall of seemingly unrelated items. This organizational strategy has been shown by an individual's tendency to recall unrelated items or words in the same order on successive recall trials of randomly presented information.

Memory is an active component in the learning process. Learning theorists have discussed, debated, and researcher memory and its relationship to learning. Memory processing models have been developed to explain how memory works. To understand and facilitate learning, research into the memory process continues to be conducted.

Rationale

Early theories and research, such as Associationism, Darwinism, and Gestalt Psychology, gave justification to the importance of memory in the learning process (Tarpy & Mayer, 1978). The ability to remember knowledge and learned skills was shown to be necessary for human survival (Adams, 1980).

Memory has been studied in normal and mentally handicapped individuals. Many researchers agree that mentally handicapped individuals can retain information in long-term memory in the same capacity as normal individuals (Belmont, 1966; Ellis, 1963). However, it is known that mentally retarded individuals tend to require overlearning of a task for information to ultimately be stored in long-term memory. Deficits in the usage of memory by mentally handicapped individuals appear inherent in short-term memory (Brown, 1974; Butterfield, Wambold, & Belmont, 1973; Ellis, 1963, 1970; Scott & Scott, 1968).

Researchers in the field of memory (Borkowski, 1965; Butterfield, Wambold, & Belmont, 1973; Ellis, 1963; MacMillan, 1970; Spitz, 1966) have suggested that mentally handicapped individuals have a deficiency in short-term memory. Two explanations of these short-term memory deficits were advanced by Ellis (1963) and Spitz (1966).

Ellis (1963) developed the multiprocess memory model and advanced the stimulus trace hypothesis. Ellis (1963) hypothesized that a difference existed between normal and mentally handicapped individuals in short-term memory. The short-term memory difference may be explained by the shorter duration of the input (i.e., stimulus trace), and its lack of intensity in mentally handicapped individuals due to the lessened integrity in the central nervous system of the mentally retarded. Therefore, the need to rehearse (e.g., overlearn) became a key to efficient short-term memory use.

Spitz (1966) advanced the organizational hypothesis and postulated that mentally handicapped individuals may not be able to organize incoming stimuli as well as normal individuals. The inability to organize may have been due to organizational abilities of the mentally handicapped rather than due to a faulty internal memory process as proposed by Ellis (1963).

No matter which theory is supported, of utmost concern to individuals working with mentally handicapped students are the students' apparent inefficient short-term memory skills. Specifically, efficient short-term memory skills are not evident with trainable mentally handicapped (TMH) individuals (Cegelka & Prehm, 1982; Mercer & Snell, 1977). Teacher training curricula continue to show an emphasis on information organization and rehearsal as instructional methods for TMH students. Organization strategies and rehearsal are considered major components of memory use.

The major goal in TMH curricula continues to be training students to function successfully in society. The students must rely on memory to acquire functional skills, such as self help skills, functional academic skills, vocational skills, and leisure and recreational activities (Cegelka & Prehm, 1982; Snell, 1978). Emphasis continues to be given to systematic, organized, and repetitious strategies to train TMH students to perform as near potential as possible (Payne, Polloway, Smith, & Payne, 1981).

It logically follows that to enable TMH students to develop to their fullest potential, individuals working with the TMH population will want to employ productive strategies to aid memory development, facilitating students' learning. Organizational strategies and rehearsal have been researched on a limited and narrow basis with TMH individuals. The current study provides information regarding organizational strategies and recall which may facilitate instruction for TMH students.

Statement of the Problem

The problem investigated in the present study is the effect of types of items and rehearsal on organization and recall of a task. The fundamental question follows. Is there an effect of types of items and rehearsal on organizational strategies and recall of a bimodal input task with TMH adolescents?

The relationship between types of items and rehearsal as seen in organizational strategies and recall is important to investigate for several reasons. First, the study provides data on types of items, and rehearsal on recall of a bimodal task. Second, it is one of the few studies that investigates learning and short-term memory in TMH adolescents. Third, the study provides information that is useful to individuals who are teaching TMH students. The study has specific implications for rehearsal and presentation of information to TMH students. Finally, the study provides learning and short-term memory data that are synthesized with past research and theoretical postulates to give more understanding to the fundamental question, "How do individuals learn?"

Purpose of the Study

The purpose of this study is to examine the effects of types of items and rehearsal on organization and recall of a bimodal (auditory and visual input) task with TMH adolescents. The four major questions under investigation follow. First, does the type of item (related or unrelated) affect the number of items recalled by TMH adolescents? Second, do repeated trials (rehearsal) affect the number of items recalled by TMH adolescents? Third, do TMH adolescents organize related and/or unrelated items above a chance level? Fourth, does a relationship exist between the number of items recalled and organizational strategies used with related and unrelated items by TMH adolescents?

Nine null hypotheses addressed the four questions under investigation.

Effect of Types of Items on Recall

H1: There will be no significant difference in recall scores between related and unrelated items by TMH adolescents.

Effect of Number of Trials on Recall

H2: There will be no significant difference between the number of related items recalled on each of the five trials by TMH adolescents.

H3: There will be no significant difference between the number of unrelated items recalled on each of the five trials by TMH adolescents.

Determination of Above Chance Organization

H4: There will be no significant difference between obtained cluster organization scores and chance cluster organization scores on related items by TMH adolescents.

H5: There will be no significant difference between obtained subjective organization scores on unrelated items by TMH adolescents.

H6: There will be no significant difference between obtained subjective organization scores and chance subjective organization scores on unrelated items by TMH adolescents.

Relationship Between Recall and Organization

H7: There will be no significant correlation between number of related items recalled and obtained cluster organization scores by TMH adolescents.

H8: There will be no significant correlation between number of related items recalled and obtained subjective organization scores by TMH adolescents.

H9: There will be no significant correlation between number of unrelated items recalled and obtained subjective organization scores by TMH adolescents.

Definition of Terms

The following key terms appear throughout the study and are applied according to the following definitions.

Aided Recall provides the individual with some type of stimulus to cue a response of a learned item (Ellis, 1978).

Bimodal for the purpose of this study refers to the presentation of information using auditory and visual input.

Cluster Organization refers to the grouping related items freely recalled from a random ordered presentation of items governed by relationships among the items (Bousfield, 1953).

Free Recall is a procedure which can show how individuals use organizational strategies. It is the process of producing a response of learned items in any particular order (Ellis, 1978).

Input is a component of the memory system which enables information to enter the memory system (Spitz, 1973).

Long-Term Memory is characterized as a highly organized storage system capable of retaining essentially unlimited amounts of information for an indefinite period of time (Ellis et al., 1979).

Memory refers to the ability of an individual to retrieve information previously learned (Cegelka & Prehm, 1982).

Output refers to the process of accessing or getting at stored information (Ellis, 1978; Spitz, 1973).

Primary Organization describes factors which are independent of an individual's prior familiarity with presented information (Moely, 1977).

Recall is a process for measuring memory which requires the demonstration of learning by producing a correct response which can be measured by output (Ellis, 1978).

Rehearsal denotes the practice of recall of an item which may be either immediate or delayed, silent or overt, deliberate or involuntary. The initial perception of an item should also be considered a rehearsal (Waugh & Norman, 1965).

Related Items for the purpose of this study refer to a group of items from a particular category. For example, cat and dog are considered related items because they are both animals.

Repeated Task for the purpose of this study refers to an individual being exposed to the same set of items in a randomly presented order.

Secondary Organization describes an individual's ability to recall information based on characteristics of the presented information (Moely, 1977).

Short-Term Memory is a limited capacity system lasting a brief period, usually measured in units of seconds and minutes, in which information has the opportunity to be processed (Ellis, 1978; Ellis et al., 1979).

Storage refers to the process of holding information in the memory system (Ellis, 1978).

Subjective Organization is organization of unrelated items which is shown by an individual's tendency to recall unrelated items or words in the same order on successive recall trials when the information is randomly presented (Tulving, 1962).

Trainable Mentally Handicapped (TMH) is a student who is moderately or severely impaired in intellectual and adaptive behavior and whose development reflects a reduced rate of learning. The student generally falls between three and five standard deviations below the mean and assessed adaptive behavior falls below age and cultural expectations. (See Appendix A for criteria.)

Unrelated Items for the purpose of this study refer to a group of items from different categories. For example, dog and hand are considered unrelated items because they are from different categories (dog is an animal and hand is a body part).

Delimitations of the Study

The study was delimited by geographical restriction to a medium-size city located in the north central portion of a southeastern state. Subjects for the study were TMH students attending classes at a public day school for special education of TMH and other severely developmentally disabled students. Students from four to 22 years of age attend the self-contained TMH school. The ages of the subjects ranged from 15 to 21 years. Results of the study may not apply to TMH students at different age levels, those attending special classes in a regular school or institution, and/or residing in other parts of the country.

Limitations of the Study

The study was limited in that the subject population consisted of adolescent TMH students. Neither socioeconomic status, sex, or race were variables under investigation. There may have been a possibility of differences in the responses as related to the socioeconomic status, sex, or race of the subjects. Subjects' previous experiences with the presented items and categories may limit the study. Treatment sessions were presented by the researcher and a research assistant. The subjects may have responded differently if the treatment sessions were presented by another individual, such as one of the teachers. The bimodal slide-tape presentation may have been a limitation. If a different bimodal presentation, such as the researcher naming the items and showing drawings, were used the subjects may have responded differently.

Summary

Donahoe and Wessells (1980) stated, "Memory is necessary for learning. There could be no learning if there were no memory, for the effects of experience could not carry over from one time to the next. Since memory is an important part of learning, we must seek to understand memory in our attempt to gain a comprehensive understanding of learning" (p. 410).

Individuals working with TMH students are concerned about TMH students' ability to learn through memory use. The proposed research was undertaken to investigate a component of the memory process with TMH adolescents. The purpose of this research was to examine the effects of types of items and rehearsal on organization and recall of a bimodal input task with TMH adolescents. Results from this research were analyzed and compared to other memory process research with mentally retarded and normal populations. Results also provided implications for instruction with TMH students.

Overview of Remaining Chapters

Chapter II presents a brief review of learning theory, the role of organization in memory, types of organization, critical analysis of organizational measures, a synthesis of organization and recall memory studies with normal and mentally handicapped subjects, and an overview of the remaining chapters. Chapter III includes the research design, questions under investigation, description of subjects, procedures, treatment conditions, data analysis, and an overview of the remaining chapters. Presented in Chapter IV are the results of the study, including data analysis procedures, analysis of the data, summary of results, and an overview of the final chapter. Chapter V includes an overview of the study, a brief review of related literature, summary of methodology, discussion of findings, observations and limitations, practical implications, and suggestions for further research.

CHAPTER II

REVIEW OF RELATED LITERATURE

The need for effectively using memory as a process of learning is evident (Adams, 1980; Donahoe & Wessells, 1980). Early learning theorists in Associationism, Darwinism, and Gestalt Psychology emphasized the importance of memory to learning. Memory processing models were developed to explain how knowledge was acquired and recalled. Organization was a key component in efficient knowledge acquisition and recall. The proposed study was undertaken to investigate a component of the memory process with trainable mentally handicapped (TMH) adolescents. Specifically, the effects of types of items (related or unrelated) and rehearsal (number of items) on organization (cluster and subjective) and items recalled was researched.

Information for the review of related literature was obtained through a wide variety of sources. The Educational Index, Dissertation Abstracts, CIJE (Current Index to Journals in Education), ERIC - Educational Documents Abstracts, and RIE (Resources in Education) were used as initial referring sources.

Textbooks, professional books, dissertations, journals, information on microfiche, and personal correspondence were other sources used to further develop the review of literature.

After an extensive review of related literature the included studies were divided into four areas. First, to help understand investigations into the process of memory, a brief background on learning theory is presented. Second, based on the theoretical foundation of learning, the role of organization in memory is discussed. Types of organization are examined third. Presented fourth are major measurement formulas that were developed to quantify organizational strategies. Major organization and recall studies are then examined followed by an overview of the remaining chapters.

Learning Theory in Brief

Learning theory has branched in numerous directions based on the foundation developed by early Greek philosophers. Three major areas included Associationism, Darwinism, and Gestalt Psychology. To understand theories of memory it is advantageous to briefly consider theories of learning because memory is an integral part of learning.

Associationism philosophy was built on the belief that learning occurred through experience. The mind (i.e., memory) was considered a blank tablet. As an individual experienced different events, the mind was developed. A major premise of Associationism was that the mind or memory process did not act on the perceived information. The function of memory was only to record the information or experience.

Darwinism was another major area of learning theory. Darwin (1809-1882) advanced two basic premises. One was the concept survival of the fittest and the other concept, evolution. Based on the two premises, studies of learning in animals were conducted with the belief that the knowledge gained would be applicable to human learning (i.e., memory).

Gestalt Philosophy was built on the belief that learning could not be adequately explained simply by having the mind (i.e., memory) receive information as shown in Associationism theory. A given experience was considered greater than the sum of its parts and therefore the mind actually processed information. Built on the belief that the mind processed information, the concept of memory as a processing unit was advanced.

Role of Organization in Memory

According to several researchers the memory processing unit was comprised of three major components including input, storage, and output (Atkinson & Shiffrin, 1968; Ellis, 1970; Spitz, 1973). A key concept that enabled the components of the memory process to work effectively was organization.

Memory and Organization

An important characteristic of efficient human memory is that it is organized. The organizational process aids an individual's ability to remember information. Bartlett (1932) viewed the act of remembering as "built out of the relation of our attitude toward a whole active mass of organized past reactions or experience" (p. 213). The organization process in memory takes place, according to Mandler (1967), when a consistent relation among the members of a set of objects or events can be specified. The relation occurs when membership of the objects or events in subsets (e.g., groups, concepts, categories, or chunks) is stable and identifiable. Thus, the apparent role of the organizational process is to aid an individual in remembering or recalling information.

Organization and Recall

In order to investigate memory researchers have examined the organizational processes that enable an individual to recall information. Studies using free recall have been conducted to investigate how an individual organizes information. Information (e.g., items, words, or pictures) in a free recall task can be recalled in any order, enabling researchers to investigate memory organization processes. Tulving (1968) suggested two major types of organizational processes in memory.

Types of Organization

A distinction between two types of organization processes in memory has been suggested by Tulving (1968). The distinction is between primary organization and secondary organization. A discussion of primary organization has been presented first. Next, secondary organization, which was the focus of the current study, has been discussed.

Primary Organization

One of the types of organization that can influence recall is primary organization. Primary organization describes an individual's recall that is independent of prior familiarity with information or a list of items presented for recall. Superior recall of items that have appeared at the beginning or end of a presented list may be attributed to primary organization. Superior recall of items presented at the beginning of a list is called the primacy effect. Recency effect is the superior recall of items presented at the end of a list. The next type of organization to be discussed is secondary organization.

Secondary Organization

Secondary organization refers to an individual recalling information based on characteristics of the presented information or items themselves. This includes recalling items on the basis of common features of form or meaning when no such grouping is apparent when the items are presented. Secondary organization can be subdivided into cluster organization and subjective organization.

Cluster organization.

Cluster organization refers to the process of recalling information or items based on the relationship among the presented items. For example, if the following items were presented: dog, cat, car, bird, and truck; and the order of information recalled by an individual was dog, cat, bird, car, and truck, it may be inferred that the individual employed cluster organization strategies. The individual was organizing information by categories (i.e., relationships) to facilitate recall. To use cluster organization the relationships among items are known. With subjective organization the relationships are not obvious.

Subjective organization. Subjective organization is a process by which individuals impose their own organizational strategies to aid recall of seemingly unrelated items. Tulving (1962) suggested that evidence for organization of unrelated items would be revealed by an individual's tendency to recall unrelated items in the same order when the items were randomly presented numerous times. For example, the following two lists might be presented (a) dog, house, arm, and paper and (b) dog, paper, house, and arm. If the individual recalled arm, paper, and house from the first list and dog, paper, and house from the second list, Tulving would infer that a relationship (i.e., organizational strategy) between paper and house was imposed by the individual. The relationship developed by the individual is an example of subjective organization.

Organization Measurement

To be able to thoroughly study a phenomenon, a researcher must quantify the information related to that phenomenon. Statistical techniques, which enable researchers to quantify and measure information about memory organization processes, are discussed in the next section.

Cluster Organization Measures

To obtain the data for analysis by a cluster organization formula three steps are followed. First, a list of related items (e.g., words or pictures) arranged in random order is developed. Second, the items are randomly presented in one or more trials. Third, the subject is asked to remember the presented items using free recall (e.g., verbal or written responses). The procedure described above allows a cluster organization measure to be applied to the data to examine the possible grouping or "clustering" of the items.

Five different formulas which measure cluster organization were developed by Bousfield (1953), Robinson (1966), Bousfield and Bousfield (1966), Frankel and Cole (1971), and Roenker, Thompson, and Brown (1971). These measures are included for discussion as they have been widely used in research similar to the current investigation. The statistical formulas for each measure are presented in Appendix B.

RR measure. Bousfield (1953) developed the ratio of repetition (RR) to measure cluster organization. The RR was a simple, straightforward measure. The RR formula was a simple ratio of the number of repetitions which occurred (obtained repetitions) to the total number of repetitions possible. Frender and Doubilet (1974) believed it was one of the best measures of cluster organization because its score, on the basis of random sampling, was independent of the words actually recalled and it was a relatively simple formula.

Two weaknesses of the RR were the measure did not take into account the transition from one category to another and that it was not independent of the number of categories represented by the words recalled (Shuell, 1969).

ICI measure. Robinson (1966) developed the item-clustering index (ICI) which addressed the category transition weakness of the RR measure. This minor change allowed for the possibility of perfect clustering in spite of gaps in repetitions resulting from categorical transitions. A minor problem with the ICI measure was that it did not take into consideration the possible occurrence of perfect clustering for the words actually recalled (Shuell, 1969). A major issue of cluster organization, still not addressed in the ICI or RR measures, was that the occurrence of chance cluster organization had not been considered. Therefore, even though the amount of cluster organization which occurred was measured, the researcher did not know whether the amount was above a level of chance.

Another problem of both the RR and ICI measures was that they were based on the assumption that all items presented for learning were equally available for recall. Researchers have noted that this may have been a faulty assumption (Murdock, 1962; Shuell, 1969; Tulving & Patterson, 1968). Since it may not have been reasonable to assume that all items were equally available for recall, and because chance values had not been considered, Bousfield and Bousfield (1966) developed another cluster organization measure.

Deviation measure. Bousfield and Bousfield (1966) developed a cluster organization measure known as the Deviation Measure. The two formulas, which comprise the Deviation Measure, were an attempt to develop a more useful cluster organization measure by expanding Bousfield's (1953) formula. A chance value of cluster organization could now be calculated which Bousfield and Bousfield called the expected stimulus category repetition, E(SCR). The chance value, E(SCR), could then be compared to the obtained stimulus category repetition, O(SCR). The obtained value was calculated using a formula similar to the RR measure. The development of the Deviation Measure enabled a more thorough and useful investigation into cluster organization strategies. In the studies reviewed, the Deviation Measure was the most frequently used cluster organization formula.

When investigations of cluster organization were conducted using lists of different lengths, the Deviation Measure was not considered appropriate. A weakness of the Deviation Measure was that no allowance was made for the maximum amount of clustering obtained with the recalled items. This limitation became significant when lists of different lengths were used (Shuell, 1969). For example, perfect clustering could be obtained in a short list; yet the value of the Deviation Measure could be less than that obtained in a not perfectly clustered longer list. However, by converting to a measurement of proportion (i.e., ratio measure) this problem could be avoided.

To compare experiments with different numbers of items and/or categories, two more cluster measures were developed. Frankel and Cole (1971) and Roenker, Thompson, and Brown (1971) developed the Z measure and the ARC measure in an attempt to circumvent the inherent problems in previously developed measures.

Z measure. Frankel and Cole (1971) developed a Z measure. The purpose of standard scores (i.e., Z scores) was to allow the comparison of an individual's relative position on two different tests or measures (Ary, Jacobs, & Razavieh, 1979). In cluster organization, the Z measure allowed for the comparison of an individual's performance on lists of different lengths. There were two major weaknesses in the cluster organization Z measure. First, the Z measure may have underestimated the degree of categorical organization used by an individual. The same Z score could have been obtained disregarding the number of categories represented by any two lists. Second, when overall recall was low, the Z score may have overestimated the amount of clustering that had occurred (Frender & Doubilet, 1974).

ARC measure. Another ratio measure, the adjusted ratio of clustering (ARC), was proposed by Roenker, Thompson, and Brown (1971). This measure was simply a ratio between the total number of category repetitions (obtained value) including the chance value and the maximum possible category repetitions including the chance value. Once a ratio score was obtained, scores using lists of different lengths could be compared. The major weaknesses of the ARC measure, which was based on the categorical composition of the individual's recall, were the same as the Z measure. The ARC measure may also underestimate cluster organization and be inappropriate in research when few items have been recalled (Frender & Doubilet, 1974).

Colle (1972) and Shuell (1975) stressed the importance of considering theoretical assumptions which should underlie the different cluster organization measures. Shuell (1969) reported a general tendency for the cluster organization measures to correlate highly with one another. According to Shuell (1969), whether or not one measure was better than another should not have been debated. Rather, the concerns should have revolved around the different theoretical assumptions on which a specific measure had been developed. In the next section subjective organization measures are presented.

Subjective Organization Measures

To obtain the data for analysis by a subjective organization formula three steps are followed. First, a list of unrelated items (e.g., pictures or words) arranged in random order is developed. Second, the items are randomly presented in more than one trial (multitrials). Third, the subject is asked to respond using free recall (e.g., verbal or written responses). The above procedure allows a subjective organization measure to be applied to the data. Comparisons are then made of the subject's adjacent trial responses.

A similar grouping of items on two consecutive random ordered trials indicates the degree of subjective organization used in the lists of unrelated items.

Three of the formulas which measure subjective organization were developed by Tulving (1962), Bousfield and Bousfield (1966), and Gorfein, Blair, and Rowland (1968). The measures included for discussion have been widely used in research similar to the current study. The statistical formulas for each measure are presented in Appendix B.

SO measure. Tulving (1962) developed an initial measure of subjective organization (SO). It provided a means for quantifying sequential redundancy of unrelated items in random ordered free recall trials. Patterns of freely recalled unrelated items could be quantified and investigated. Tulving's (1962) formula represented a ratio score of obtained organization to maximum organization. The SO measure could be considered to parallel Bousfield's (1953) RR measure. Even though Tulving's formula measured subjective organization and Bousfield's formula measured cluster organization, both formulas compared an obtained organization score to a maximum organization score.

Two major weaknesses were evident in Tulving's procedure. First, the SO procedure did not allow for the calculation of whether or not the amount of subjective organization obtained differed significantly from the amount expected by chance. The absence of a chance value score had also been a concern with the cluster organization RR measure. The second weakness of the SO measure was that item pairs were measured in only one direction (unidirectional sequence).

ITR measure. To make subjective organization measurement more useful to researchers, Tulving's (1962) SO measure was expanded by Bousfield and Bousfield (1966). The intertrial repetition measure (ITR) was developed to consider the amount of subjective organization that may occur by chance alone. The ITR measure allowed the calculation of whether or not the amount of subjective organization obtained differed significantly from what was expected by chance alone. Bousfield and Bousfield (1966) called the obtained subjective organization, obtained intertrial repetition or O(ITR), and the chance subjective organization, expected intertrial repetition or E(ITR). The weakness of a unidirectional measure was still inherent to the ITR measure.

(E) measure. A modification to Bousfield and Bousfield's (1966) ITR measure was made by Gorfein, Blair, and Rowland (1968). The modification addressed the weakness of the unidirectional measure by permitting a bidirectional calculation of the ITR. The modification was made to the E(ITR) formula. Gorfein, Blair, and Rowland's expected value of intertrial repetitions (E), for example, not only allowed for responses in Trial 1 of cat-dog and Trial 2 of cat-dog to be measured but also allowed responses of cat-dog in Trial 1 and dog-cat in Trial

2 to be measured. Anderson and Watts (1969) suggested a bidirectional measure of organization was more sensitive than a unidirectional measure and, therefore, a better measure to use. Gorfein, Blair, and Rowland compared the (E) Measure to the obtained intertrial repetition score. It was the same score Bousfield and Bousfield labeled O(ITR). Gorfein et al. called it the (O) measure.

In the subjective organization research reviewed for this chapter Bousfield and Bousfield's (1966) ITR measure was used most frequently, even though the (E) Measure of Gorfein et al. may be considered a stronger measure. An explanation may be that Bousfield and Bousfield's (1966) formula was more widely known based on the published research they conducted in the use ofcluster and subjective organization. The ITR measure was published in a widely read journal, whereas the (E) Measure was published in a lesser known journal. Gorfein et al. (1968) also published less information on organization research. These factors may have contributed to the determination of which subjective organization formulas other researchers used. The next section presents data-based organization and recall research.

Organization and Recall Studies

For many years, researchers have investigated organizational strategies and free recall. Based on an extensive review of related literature, studies that met the following criteria have been included. First, the studies were data-based. Second, the independent variables were lists of related or unrelated pictures or objects. Third, verbal free recall and cluster organization or subjective organization were the measured dependent variables.

The reviewed literature is presented in three sections. First, cluster organization and recall research are discussed. Second, subjective organization and recall studies are reviewed. Third, research most similar to the current study, which investigated cluster organization, subjective organization, and recall, is presented.

Cluster Organization and Recall Studies

The dependent variables, cluster organization and recall, have been measured in studies which used lists of pictures or objects as the independent variables. These ten studies are presented chronologically in Table 1.

Weatherwax and Benoit (1957) studied the use of cluster organization by mentally handicapped individuals. Fifty subjects, with an approximate mean age of 12 years and classified as organic or non-organic brain-injured, participated in the study. Twelve pictures, in four categories, were used across six trials. The subjects' named each picture as it was presented and then their free recall responses were recorded. Bousfield's (1953) RR measure was used to calculate cluster organization scores based on the free recall responses.

Results presented by Weatherwax and Benoit (1957) indicated that the subjects used cluster organization strategies and there was no

Table 1

Cluster Organization and Recall Studies

Author(s)	Subjects	Procedures	Analysis	Results	Weaknesses
Weatherwax & Benoit (1957)	N = 50: 25 organic, $\overline{\text{CA}}$ = 148 mos. $\overline{\text{MA}}$ = 72 mos. $\overline{\text{IQ}}$ = 50 25 inorganic, $\overline{\text{CA}}$ = 143 mos. $\overline{\text{MA}}$ = 72.4 mos. $\overline{\text{IQ}}$ = 52	12 pictures, 4 categories, 1 exposure every 4 sec., 6 trials, 30 sec. free oral recall	RR (Bousfield, 1953)	CO occurred with both groups; no significant difference between groups using CO (cluster organization)	Same word recalled more than once was counted as another cluster when linked with another word; recall not investigated
Osborn	N = 60: 20 organic, mild MR 20 familial, mild MR 20 normal, CA range 10-30 yrs., MR IQ range 45-70, MR Groups matched on MA (5-11 yrs.)	32 items, 4 categories, slide presentation, 1 recorded trial	RR (Bousfield, 1953)	No significant difference between groups on recall or using CO	Only 1 recorded trial

Table 1 -- Continued

Author(s)	Subjects	Procedures	Analysis	Results	Weaknesses
Gerjuoy, Winters, Pullen, & Spitz (1969) Experiment I	N = 48 24 EMR, institutionalized, $\overline{CA}$ = 15.6 yrs. $\overline{IQ}$ = 64 24 normal, $\overline{CA}$ = 10.6 yrs. $\overline{IQ}$ = 110 groups matched on MA	10 pictures, 4 categories, half subjects in each group received random presentation, other half clustered presentation, each trial 3 sec. exposures with 7 sec. intervals, 5 trials, 2 min. free recall response	Bousfield & Bousfield (1966) Deviation Measure	Recall significantly increased over trials, both groups used CO above chance and increased over trails, normals clustered more than EMR's, more clustering occurred with clustered input than random input	Confounding effect institutionalization and retardation; specific stimulus items not given
Gerjouy et al. (1969) Experiment II	N = 48: 24 EMR, institutionalized, $\overline{CA}$ = 16.3 yrs. $\overline{IQ}$ = 63 24 normal, $\overline{CA}$ = 10.7 yrs. $\overline{IQ}$ = 110 groups matched on MA	20 pictures, 40 items, 2 per card, 4 categories, half subjects in each group presented items in random manner, other half received items in clustered presentation, 3 sec. exposures, 7 sec. intervals, 5 trials, 2 min. free recall response	Bousfield & Bousfield (1966) Deviation Measure	Normal recalled more than EMR, over trials CO increased more rapidly with normals, clustered presentations improved recall which also improved over trials, total items recalled was greater with 40 items when compared to the 10 items in Experiment I	Pair presentation may have also influenced results; confounding effect institutionalization and retardation; specific stimulus items not given

Table 1 -- Continued

Author(s)	Subjects	Procedures	Analysis	Results	Weaknesses
Gerjuoy & Winters (1970) Session I	N = 80: institutionalized EMR's, 40 male, 40 female $\overline{CA}$ = 15.8 yrs. $\overline{IQ}$ = 65	2 lists, 20 pictures, 4 categories each, items presented single-random, single-clustered, 2 sec. exposure of single items, 2 min. free recall response, 5 trials	Bousfield & Bousfield (1966) Deviation Measure	No differences in recall among conditions, recall and CO improved over trials, CO occurred above chance in all conditions, clustering increased at a significantly faster rate with grouped stimuli, bimodal presentation produced superior recall when compared to Gerjuoy & Spitz's (1966) study	Confounding effects institutionalization and retardation
Session II	Same as above	Stimulus same as above, single-random same as above, auditory-random, time and trials same as above	Bousfield & Bousfield (1966) Deviation Measure	No significant difference between auditory random recall scores and random condition in Gerjuoy and Spitz's (1966) study, significantly better recall with bimodal presentation than auditory presentation, CO above chance both conditions, auditory presentation produced significantly more clustering than the random condition in Gerjuoy and Spitz's (1966) study	Same as above

Table 1 -- Continued

Author(s)	Subjects	Procedures	Analysis	Results	Weaknesses
Herriot (1972) Experiment II	N = 40: 20 mongoloids, $\overline{CA}$ = 23.3 yrs. $\overline{MA}$ = 4.9 yrs. 20 nonmongoloids, $\overline{CA}$ = 24.1 yrs. $\overline{MA}$ = 4.9 yrs. $\overline{IQ}$ = 20	Reviewed 3 categories, 6 slides of familiar objects, Condition I randomly named objects during each review, Condition II named objects in same order during each review, 30 sec. exposures, 6 trials, 1 day between conditions	Bousfield & Bousfield (1966) Deviation Measure	Random condition produced more clustering only on Day 2 for mongoloid subjects and Day 1 for nonmongoloid subjects, nonmongoloid subjects recalled better than mongoloid subjects	Subject identification not specified, results unclear, one day between conditions
Palmer (1974)	N = 60: 30 institutionalized EMR's, $\overline{CA}$ = 22.3 yrs. $\overline{IQ}$ = 65.8 $\overline{MA}$ = 9.5 yrs. 30 normal $\overline{CA}$ = 8.7 $\overline{IQ}$ = 105.2	18 objects (9 pairs), exposed 2-3 sec., 90 sec. for free recall, 5 trials	Bousfield & Bousfield (1966) Deviation Measure	Both groups significant CO on all trials, normals had higher cluster scores than EMR's on trials 3, 4, 5, no difference between groups on recall, recall significantly improved over trials for both groups	Confounding effect of institutionalization and retardation

Table 1 -- Continued

Author(s)	Subjects	Procedures	Analysis	Results	Weaknesses
Riegel & Taylor (1974)	N = 117: 86 EMR's, $\overline{\text{CA}}$ = 8 yrs. $\overline{\text{IQ}}$ = 70 31 nonretarded 2nd graders $\overline{\text{CA}}$ = 8 yrs.	20 pictures, used different sorting techniques, 1 trial each method	Frankel & Cole (1971) Z Measure	No difference in CO scores, both groups significant correlation recall and CO, normal recalled significantly more than EMR's, normals used higher levels of sorting than EMR's	Only 1 trial Subject selection: IQ of normal subjects not reported, information not given on EMR population regarding institutionalized or not
Becker & Morrison (1978)	N = 235: 57 normal 87 LD 91 EMR MA ranges 5-7, 7-9, 9-11	4 categories with 4, 5, or 6 pictures given to respective MA levels, random blocked or active sorting conditions, 1 recorded trial	ICI Robinson (1966)	Clustering scores were not significantly different for the 3 groups, clustering scores in the random condition for three MA levels were significantly less than in the blocked and sort conditions, clustering scores for the MA 5-7 group were significantly less in the sort condition than in the blocked condition, for the 9-11 group, block condition scores were lower than sort and condition scores	Subject selection: Young LD students were normal students in regular classes identified by regular teachers as having academic achievement problems, study conditions generalizability of EMR and LD results because of unclear differentiating characteristics, ICI measure does not evaluate a chance clustering level, only 1 trial given

difference in cluster organization scores between organic and non-organic brain-injured children. Cluster organization in relation to the number of items recalled was not investigated. When the items were recalled more than once they were counted again as a cluster if linked with another item in the same category. This procedure conflicted with the majority of later cluster organization research which considered a word recalled more than once as an intrusion and did not include it in the analysis. By including a repeated item in the cluster organization analysis the tendency might have been for the cluster organization score to be raised.

Another study was conducted by Osborn (1960) and compared normal and mentally handicapped subjects. The subjects in the study included 20 mildly mentally handicapped (cause: organic) and 20 mildly mentally handicapped (cause: non-organic) individuals between the ages of 10 and 30 years. Twenty normal subjects were matched to the handicapped subjects on mental age (MA). Thirty-two pictures, in four categories, were shown to the subjects in three consecutive random trials. The subjects named the items as they were presented. One free recall trial was recorded and cluster organization scores were measured using Bousfield's (1953) RR measure.

No significant differences were found between the mildly mentally handicapped and normal subjects on recall or cluster organization (Osborn, 1960). The nonsignificant difference between the groups may have been a result of using only one trial. Other studies, such as Gerjuoy and Winters (1970) and Gerjuoy, Winters, Pullen, and Spitz (1969), have suggested that recall scores and cluster organization scores change over repeated trials.

Two experiments by Gerjuoy et al. (1969) were conducted to investigate the use of cluster organization and recall with normal children matched on MA with institutionalized educable mentally handicapped (EMH) adolescents. Twenty-four children with a mean age of 10.6 years were matched to 24 EMH adolescents with a mean age of 15.6 years. These experiments used Bousfield and Bousfield's (1966) Deviation Measure to analyze cluster organization scores. The Deviation Measure was considered a more useful measure than the RR measure, because the level of chance clustering could be calculated. The RR formula had been used in Weatherwax and Benoit's (1957) and Osborn's (1960) research.

In Experiment I, Gerjouy et al. (1969) presented 20 items, in four categories, in five random trials. The pictures were presented in either a clustered or nonclustered order. The subjects' free recall responses were recorded after each trial.

Results calculated with Bousfield and Bousfield's (1966) Deviation Measure showed recall significantly increased over trials, both groups used cluster organization above chance, normal subjects clustered more than EMH subjects, and the clustered presentation elicited more clustering by the subjects than the random order presentation. There was no significant difference on recall scores between the normal and mentally handicapped subjects.

In Experiment II, Gerjuoy et al. (1969) presented 40 paired items, in four categories, to 24 normal children and 24 EMH adolescent subjects matched on MA. The pictures were presented in either a random order or clustered order across five trials. Bousfield and Bousfield's (1966) cluster organization measure was used in the analysis.

Results indicated normal subjects clustered and recalled significantly more than EMH subjects and that the clustered presentation facilitated recall. Cluster organization also increased more rapidly over trials for the normal subjects when compared to the EMH subjects.

An analysis of the two studies revealed two points for further discussion. First, the items used in the studies were not reported. Second, Gerjuoy et al. (1969) found that more items were recalled in Experiment II (40 paired items) than recalled in Experiment I (20 single items). The researchers indicated that doubling the amount of input doubled the amount of output (i.e., recall) by the EMH subjects. The doubled output may have resulted not only from list length but also because the items were paired. This seems a logical explanation based on Miller's (1956) theory on "chunking." Miller's (1956) theory suggested an individual would group information together in "chunks" (e.g., pairs) to aid in recall.

Another study, which also used institutionalized EMH adolescents, was conducted by Gerjuoy and Winters (1970). The experiment was carried out in two sessions. Twenty pictures, from four categories, were presented verbally and visually, across five random trials. The eighty subjects' free recall responses were recorded. Recall and cluster organization were investigated using Bousfield and Bousfield's (1966) Deviation Measure.

The results, presented and discussed by Gerjuoy and Winters (1970), indicated cluster organization occurred above chance, recall and cluster organization improved over trials and no differences were found between females and males on recall. Also "better" (sic) recall resulted from the bimodal presentation.

Cluster organization by 40 severely handicapped adults as the subjects was the focus of Herriot's (1972) study. Herriot presented six pictures in three categories, using six random trials, to the subjects. The "mongoloid" and "nonmongoloid" (sic) subjects were compared in two treatments. In one condition, the subjects randomly named the pictures and in the other condition, the subjects named the pictures in the same order on each trial. The results of Herriot's (1972) study were analyzed using Bousfield and Bousfield's (1966) Deviation Measure.

Herriot's (1972) results showed random order produced more clustering in one session for one group of subjects and more clustering in another session for the other group of subjects. These reported results were unclear. The criteria used to distinguish between the two groups of subjects were not specified and the groups may have been more homogeneous than expected.

The seven research studies previously discussed had been conducted using pictures. Palmer (1974) introduced objects as the stimuli. Thirty institutionalized EMH adults were matched on MA to 30 normal children. Five trials of nine pairs of objects were presented to the subjects. The results of the five recall sessions were analyzed using Bousfield and Bousfield's (1966) Deviation Measure.

Palmer (1974) found that both groups had significant cluster organization scores, no differences on recall, and recall significantly improved over trials. Normal subjects had higher cluster scores than EMH subjects on the last three trials. Osborn (1960) also found that when EMH subjects were matched to normal subjects on MA there was no significant difference in recall.

The effect of subjects actually manipulating (i.e., sorting) items to facilitate recall was investigated by Riegel and Taylor (1974). Normal children and EMH children were administered the Sampling Organization and Recall Strategies Tests. These tests required the subjects to name and sort 20 pictures from three categories. A single recall trial was given and the results were analyzed using Frankel and Cole's (1971) Z measure.

Results of Riegel and Taylor's (1974) study showed no differences in cluster organization scores and a significant correlation between recall and cluster organization for both groups. Results also indicated that normal subjects recalled significantly more pictures than the EMH subjects.

Riegel and Taylor (1974) indicated that the lack of differences in cluster organization between the normal and EMH subjects may have been due to the young age of the subjects, task of the study, and/or the cluster measure used in the analysis. A weakness of the study was that the mean I.Q. of the normal group was not reported. The two groups may have been similar based on I.Q.

One of the most recent studies investigating cluster organization and recall used normal, learning disabled (LD), and EMH students. Becker and Morrison (1978) conducted the study with 57 normal, 87 LD, and 91 EMH students in three groups based on mental ages of 5-7, 7-9, and 9-11 years. Four categories with four, five, or six pictures were presented to the students on the respective MA levels. One trial was recorded after the subjects participated in either a random, blocked or active sort condition. Robinson's (1966) ICI measure was used to analyze the data.

Becker and Morrison's (1978) results revealed that clustering scores were not significantly different for the EMH, LD, or normal subjects and that the random condition cluster scores for all MA levels were significantly less than the other two conditions. For the MA 5-7 group the cluster scores were significantly less in the sort condition than in the blocked condition while the opposite was found with the MA 9-11 group. A weakness of Becker and Morrison's (1978) research included a problem with subject selection (e.g., unclearly differentiated EMH and LD subjects). Another major problem was that the measure chosen to analyze the data did not evaluate a chance level of clustering. Therefore, even though clustering occurred it was not known whether or not it occurred above a chance level.

Cluster organization and recall have been investigated using pictures or objects as the stimuli. The ten research studies reviewed in this section included studies using mild, moderate, and severely handicapped subjects. Some of the studies compared mentally handicapped and normal subjects use of cluster organization and recall. Subjective organization and recall have also been researched.

Subjective Organization and Recall Studies

Researchers have measured the subjective organization and recall of mentally handicapped subjects. The two studies presented in Table 2 used pictures or objects as the stimuli. Herriot (1972) and Mende (1974) conducted the research.

Herriot (1972) conducted a study with 40 severely mentally handicapped adults to examine the effect of order labeling on subjective organization and free recall. Seven random trials, using six simultaneously presented unrelated items, were measured. The "mongoloid" and "nonmongoloid" (sic) subjects were exposed to either a same order labeling condition or a random order labeling condition. Bousfield and Bousfield's (1966) ITR measure was used.

The results reported by Herriot (1972) indicated that same order verbal labeling increased subjective organization when compared to random order verbal labeling. A problem with this study was that the population was not adequately described.

Table 2

Subjective Organization and Recall Studies

Author(s)	Subjects	Procedures	Analysis	Results	Weaknesses
Herriot (1972) Experiment I	N = 40: 20 mongoloid $\overline{CA}$ = 23.3 yrs. $\overline{MA}$ = 4.9 yrs. 20 nonmongoloid $\overline{CA}$ = 24.1 yrs. $\overline{MA}$ = 4.9 yrs. IQ = 20	Pretest given, 6 familiar, unrelated items, presented on one slide, 7 randomly arranged trials	ITR (Bousfield & Bousfield, 1966)	Same order labeling increased subjective organization when compared to random order labeling	Subject identification: Not specified, low IQ may have been a result of test and age
Mende (1974)	N = 40: 20 EMR $\overline{CA}$ = 9 yrs. $\overline{IQ}$ = 66.8 20 EMR $\overline{CA}$ = 14 $\overline{IQ}$ = 67.1	2 different sets of 12 unrelated items, pictures and objects, 6 trials	E Measure (Gorfein, Blair, & Rowland, 1968) Ratio Analysis (Fagen, 1968)	14 yr. olds recalled more pictures and objects than 9 yr. olds, both groups recalled more objects than pictures and recall scores increased over trials, relationship existed between recall and SO with objects for 14 yr. olds, SO occurred above chance for 14 yr. olds with objects and pictures	Objects and pictures were from separate word lists

Subjective organization and recall had also been investigated with EMH subjects. Mende (1974) compared picture and object stimuli by measuring free recall and subjective organization with 9 year old and 14 year old EMH students. Twelve unrelated objects and 12 different unrelated pictures were presented to the 40 subjects. Six trials, requiring free verbal recall, were used in both conditions. Subjective organization was measured using Gorfein, Blair, and Rowland's (1968) (E) Measure.

Results indicated older subjects recalled more items than younger subjects. Both groups recalled more objects than pictures and recalled more items across trials. In addition, a significant relationship was found between recall and subjective organization with objects and subjective organization occurred above chance with both pictures and objects for the older group.

Different subjective organization measures were used in the two studies. Herriot used a unidirectional measure to analyze the results and Mende used a bidirectional measure. The different measures might have explain why subjective organization was significant with the pictures and objects used in Mende's study and not significant with pictures used by Herriot. The obvious explanation for the different results, however, was the different mental levels of subjects in the two studies.

Research has been reviewed which investigated cluster organization, subjective organization, and recall in the same studies. These studies are presented in the next section.

Cluster Organization, Subjective Organization, and Recall

Herriot and Cox (1971) and Perlmutter and Myers (1979) conducted studies using cluster organization, subjective organization, and recall as the dependent variables. The two studies are presented in Table 3.

An investigation of cluster and subjective organization and recall with "mongoloid" and "nonmongoloid" (sic) subjects was conducted by Herriot and Cox (1971). Six simultaneously presented related pictures, shown across six random trials, were used to investigate cluster organization. Subjective organization was studied by a simultaneous presentation of six unrelated pictures across seven random trials. Bousfield and Bousfield's (1966) Deviation Measure and ITR measure were used to analyze cluster organization and subjective organization, respectively.

Herriot and Cox (1971) concluded that cluster and subjective organization existed, there was a significant interaction between cluster organization and recall, and there was a nonsignificant interaction between subjective organization and recall. Additionally, the degree of rehearsal was found negatively correlated with subjective organization and the number of repetitions was positively correlated with recall. A weakness of Herriot and Cox's (1971) research was that a clear description of the differences between the two groups of subjects was not reported.

Eight years after Herriot and Cox's (1971) research, Perlmutter and Myers (1979) investigated preschool children's recall, cluster

Table 3

Cluster Organization, Subjective Organization, and Recall Studies

Author(s)	Subjects	Procedures	Analysis	Results	Weaknesses
Herriot & Cox (1971)	N = 48: 24 mongoloid $\overline{CA}$ = 12.8 yrs. $\overline{MA}$ = 5.13 yrs. IQ = 40 24 nonmongoloid $\overline{CA}$ = 12.56 yrs. $\overline{MA}$ = 5.11 yrs. IQ = 41	3 sets of slides, 6 pictures each, pictures in each set presented simultaneously, 2 sets contained unrelated items, 1 set contained related items, 3 categories, oral responses, 6 trials measured CO (cluster organization), 7 trials measured SO (subjective organization)	CO, SO calculated using Bousfield & Bousfield's (1966) measures	CO & SO exist, significant CO and recall, nonsignificant SO and recall, degree of rehearsal negatively correlated with SO by mongoloid subjects, number of repetitions positively correlated with recall	Subject identification: not specified
Perlmutter & Myers (1979)	N = 32: 8 male, 8 female $\overline{CA}$ = 4 yrs. 8 male, 8 female $\overline{CA}$ = 2 yrs. 11 mos.	Pretest 2,3,6 training list, 9 related (3 categories) 9 unrelated objects, 3 trials	CO calculated using ARC (Roenker, Thompson, & Brown, 1971) and RR (Bousfield, 1953) SO calculated using ITR (Bousfield & Bousfield, 1966)	Number of items recalled increased with age, all subjects recalled more on the related item list, CO occurred above chance, SO was nonsignificant	Only 3 trials

organization and subjective organization. Thirty-two preschool children between the ages of two and five years were shown nine related and nine unrelated objects. The children received a training list as a pretest. The subjects then received three trials on each list. Cluster organization was measured using Roenker, Thompson, and Brown's (1971) ARC measure. Bousfield and Bousfield's (1966) ITR measure was used to analyze subjective organization. The ITR measure had also been used in the previous study by Herriot and Cox (1971).

The major findings of Perlmutter and Myers (1979) research included that the number of items the subjects recalled increased with age and the use of subjective organization was nonsignificant. All subjects also recalled more related items than unrelated items and used cluster organization above chance. A weakness of the study was only three trials were used.

Herriot and Cox's (1971) mentally handicapped subjects had an approximate MA of five years which was near the chronological age of the older preschool group in Perlmutter and Myers (1979) study. In both studies, cluster organization occurred above chance and subjective organization was nonsignificant. These findings suggested that young children and individuals with similar mental ages showed a relationship between cluster organization and recall. Herriot and Cox (1971) found the number of repetitions positively correlated with recall and Perlmutter and Myers (1979) found the number of items recalled increased with age.

Summary

The cluster organization, subjective organization, and recall studies which used pictures or objects as the stimuli have produced various results. The following summaries and comparisons of the results are presented in three major areas including recall, cluster organization, and subjective organization.

Researchers found no differences among different types of handicapped subjects and recall (Gerjuoy & Winters, 1970; Osborn, 1960; Weatherwax & Benoit, 1957). Conflicting results occurred when normal and mentally handicapped subjects were compared on recall. Palmer's (1974) recall results suggested no differences between mentally handicapped and normal subjects, whereas Gerjuoy, Winters, Pullen, and Spitz (1969) and Riegel and Taylor (1974) found normal subjects recalled significantly more than mentally handicapped subjects. Gerjuoy et al. (1969), Gerjuoy and Winters (1970), Herriot and Cox (1971), Mende (1974), and Palmer (1974) found recall significantly increased over trials for all subjects.

Results of studies investigating cluster organization indicated that cluster organization occurred at a significant level with mentally handicapped and normal subjects (Gerjuoy & Winters, 1970; Gerjuoy et al., 1969; Herriot & Cox, 1971; Palmer, 1974; Perlmutter & Myer, 1979; Riegel & Taylor, 1974; Weatherwax & Benoit, 1957). Herriot and Cox (1971) and Riegel and Taylor (1974) reported a positive correlation between recall and cluster organization.

Results from the reviewed subjective organization research were mixed. Herriot and Cox (1971) and Mende (1974) found that subjective organization was used by mentally handicapped subjects. Perlmutter and Myers (1979) reported that the use of subjective organization and recall were positively correlated with one group in Mende's (1974) research, while Herriot and Cox (1971) found no correlation between subjective organization and recall with their subjects.

Overview of Remaining Chapters

Chapter III presents the research design, questions under investigation, description of the subjects, procedures, treatment conditions, data analysis, and an overview of the remaining chapters. Results are presented in Chapter IV, including data analysis procedures, analysis of the data, summary of results, and an overview of the final chapter. Chapter V includes an overview of the study, a brief review of related literature, summary of methodology, discussion of findings, observations and limitations, practical implications, and suggestions for further research.

CHAPTER III

METHODS

The research was undertaken to examine the effect of types of items (related and unrelated) and rehearsal (number of trials) on organization (cluster and subjective) and recall with trainable mentally handicapped (TMH) adolescents. The investigation stems from the position that to gain a comprehensive understanding of how an individual learns, memory needs to be investigated (Donahoe & Wessells, 1980). The methodology of the study is presented in this chapter. The chapter is divided into eight sections including the research design, questions under investigation, description of the subjects, procedures, treatment conditions, data analysis, summary, and overview of the remaining chapters.

Research Design

The experimental design of the study was a repeated measures design which is a common form of the randomized block design. Each subject (a "block") serves in all treatment conditions. A repeated measures design, also known as a within subjects design, allows observation of differences in behavior on the same set of subjects. Treatment effects represent differences within the single group of experimental subjects (Keppel, 1982).

In experimental research, the repeated measures design has become an effective experimental design with which to study such phenomena as learning and practice effects (Keppel, 1982). The main advantage of the repeated measures design is it controls subject heterogeneity (i.e., individual differences). A major weakness of the repeated measures design is that subjects will change systematically during the experimental treatments. This overall change is known as a practice effect.

The possibility of this practice effect requires steps to be taken to avoid confounding practice effects with treatment effects that would occur if the treatments were applied to all subjects in the same order. Counterbalancing can be used to control confounding practice effects. Counterbalancing is achieved by rotating the individuals at different intervals in the experiment so the treatments will not be applied in the same order to all subjects (Ary, Jacobs, & Razavieh, 1979). Table 4 presents the repeated measures experimental design used in the study. The independent variables were types of items and rehearsal. Organizational strategies and recall were the dependent variables.

Independent Variables

Types of items (pictures), and amount of rehearsal (number of trials) were the independent variables. The 12 related items (List A) and 12 unrelated items (List B) are presented in Table 5. To generate List A and List B, one syllable words with a high frequency rating from Thorndike and Lorge's (1944) frequency tables were used.

Table 4

Research Design

		Trials									
		Phase 1					Phase 2				
		1	2	3	4	5	1	2	3	4	5
Subjects	Group 1	RSCX	RSCX	RSCX	RSCX	RSCX	USX	USX	USX	USX	USX
	Group 2	USX	USX	USX	USX	USX	RSCX	RSCX	RSCX	RSCX	RSCX

Note:

Independent Variables

R = related items (List A)
U = unrelated items (List B)

Dependent Variables

C = cluster organization
S = subjective organization
X = recall

Table 5

Items in List A and List B

List A (Related Items)	List B (Unrelated Items)
1. Bird	1. Ball
2. Fish	2. Rope
3. Horse	3. Boy
4. Cat	4. Lamp
5. Train	5. Flag
6. Plane	6. Dog
7. Boat	7. Glass
8. Car	8. Shoe
9. Eye	9. Tree
10. Nose	10. Mouth
11. Hand	11. Gate
12. Foot	12. Saw

The frequency tables presented the frequency of words occurring in reading materials. Previous cluster and subjective organization studies using pictures or objects as stimuli, with mentally handicapped subjects, have used Thorndike and Lorge (1944) high frequency tables to generate word lists (Gerjuoy & Winters, 1970; Mende, 1974; Osborn, 1960). List A consisted of three categories, animals, transportation, and body parts, with four items in each category. List B included 12 unrelated items, none of which were used in List A.

The 12 items in List A and List B were each randomized five times as shown in Table 6 and Table 7, respectively. The randomization met the following criteria. An item did not occupy the same serial position more than once and was not preceded or followed by another item more than once.

The amount of rehearsal, investigated by number of trials, was the other independent variable. There were five trials used with both List A and List B.

Dependent Variables

Three dependent variables were analyzed in the study including number of items recalled, cluster organization with related items, and subjective organization with related and unrelated items. The number of items recalled was counted. Cluster organization was quantified using Bousfield and Bousfield's (1966) Deviation Measure. Gorfein, Blair, and Rowland's (1968) (E) Measure was used to quantify subjective organization. A detailed explanation of these two cluster and

Table 6

Randomized Related Items List A

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
1. Bird	1. Fish	1. Eye	1. Plane	1. Hand
2. Foot	2. Bird	2. Fish	2. Eye	2. Plane
3. Fish	3. Eye	3. Plane	3. Hand	3. Boat
4. Car	4. Foot	4. Bird	4. Fish	4. Eye
5. Eye	5. Plane	5. Hand	5. Boat	5. Horse
6. Train	6. Car	6. Foot	6. Bird	6. Fish
7. Plane	7. Hand	7. Boat	7. Horse	7. Nose
8. Cat	8. Train	8. Car	8. Foot	8. Bird
9. Hand	9. Boat	9. Horse	9. Nose	9. Cat
10. Nose	10. Cat	10. Train	10. Car	10. Foot
11. Boat	11. Horse	11. Nose	11. Cat	11. Train
12. Horse	12. Nose	12. Cat	12. Train	12. Car

Table 7

Randomized Unrelated Items in List B

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
1. Ball	1. Boy	1. Saw	1. Glass	1. Lamp
2. Rope	2. Ball	2. Boy	2. Saw	2. Glass
3. Boy	3. Saw	3. Glass	3. Lamp	3. Shoe
4. Tree	4. Rope	4. Ball	4. Boy	4. Saw
5. Saw	5. Glass	5. Lamp	5. Shoe	5. Gate
6. Dog	6. Tree	6. Rope	6. Ball	6. Boy
7. Glass	7. Lamp	7. Shoe	7. Gate	7. Mouth
8. Flag	8. Dog	8. Tree	8. Rope	8. Ball
9. Lamp	9. Shoe	9. Gate	9. Mouth	9. Flag
10. Mouth	10. Flag	10. Dog	10. Tree	10. Rope
11. Shoe	11. Gate	11. Mouth	11. Flag	11. Dog
12. Gate	12. Mouth	12. Flag	12. Dog	12. Tree

subjective organization measures are presented in Appendix C. In the data analysis section, additional information is presented on the cluster and subjective organization measures.

Questions Under Investigation

The study was conducted to investigate four major questions.

1. Does the type of item (related or unrelated) affect the number of items recalled by trainable mentally retarded (TMH) adolescents?

2. Do repeated trials (rehearsal) affect the number of items recalled by (TMH) adolescents?

3. Do TMH adolescents organize related and/or unrelated items above a chance level?

4. Does a relationship exist between the number of items recalled and organizational strategies used with related and unrelated items by TMH adolescents?

Nine null hypotheses addressed the four questions under investigation.

Effect of Type of Item on Recall

H1: There will be no significant difference in recall scores between related and unrelated items by TMH adolescents.

Effect of Number of Trials on Recall

H2: There will be no significant difference between the number of related items recalled on each of the five trials by TMH adolescents.

H3: There will be no significant difference between the number of unrelated items recalled on each of the five trials by TMH adolescents.

Determination of Above Chance Organization

H4: There will be no significant difference between obtained cluster organization scores and chance cluster organization scores on related items by TMH adolescents.

H5: There will be no significant difference between obtained subjective organization scores and chance subjective organization scores on related items by TMH adolescents.

H6: There will be no significant difference between obtained subjective organization scores and chance subjective organization scores on unrelated items by TMH adolescents.

Relationship Between Recall and Organization

H7: There will be no significant correlation between number of related items recalled and obtained cluster organization scores by TMH adolescents.

H8: There will be no significant correlation between number of related items recalled and obtained subjective organization scores by TMH adolescents.

H9: There will be no significant correlation between number of unrelated items recalled and obtained subjective organization scores by TMH adolescents.

Description of the Subjects

Subjects for the study were 30 trainable mentally handicapped (TMH) adolescents who met the following criteria. The subjects were between the ages of 15 and 21 years and identified as TMH based on the local county school board definition and criteria for eligibility (see Appendix A). The subjects also had hearing and vision (correction allowed) within normal limits and verbalized to such a degree that the researchers could identify the verbal responses.

The descriptive statistics analysis of the subjects indicated the following. The subjects' mean age was 18 years and 3 months. The mean I.Q. for the subjects was 39. Twenty-one males and nine females participated in the study. Eighteen of the subjects were White and 12 of the subjects were Black.

The participants were randomly selected from the school population. A list of the students meeting the criteria for inclusion in the study was developed. Next, the students were assigned numbers from a table of random numbers (Ary, Jacobs, & Razavieh, 1979). The top 30 students who returned the required permission slips participated in the study. The subjects were then randomly assigned to one of the two groups. A coin flip determined that Group 1 received List A first and Group 2 received List B first.

Approval for students to participate as subjects in the study was obtained through the University of Florida Institutional Review Board, the local county school board, and by the students and their parents or guardians. A copy of the letter of informed consent was sent to the subjects and their parents or guardians and is presented in Appendix D.

Procedures

The procedures section is divided into four areas. The areas include the experimental condition, research setting, administration of the study, and the response recording instrument.

Experimental Condition

Two slide-tape presentations were developed using the items (pictures) in List A and List B (see Table 5). Black and white slides were made from pictures in the Peabody Picture Vocabulary Test, Form L and Form M (Dunn & Dunn, 1981). A Pentex 35mm single lens reflex camera with a 28mm lens and Kodak 400 tri-x film was used to make the slides. The auditory portion of the presentation of the items was recorded by a university graduate student on a Maxell-LN-90 cassette tape. A Kodak slide carousel projector with a Wollensak synchronizing unit was used to present the items in List A and List B to the subjects.

A four-second time interval was used for the slide-tape presentation. Every four seconds a slide was shown and the subject also heard the word. The four-second interval was chosen based on previous cluster and subjective organization studies, using mentally handicapped subjects, which reported time interval information. The reported time intervals ranged from 2 to 8 seconds (Gerjuoy & Winters, 1970; Gerjuoy, Winter, Pullen, & Spitz, 1969; Herriot & Cox, 1971; Mende, 1974; Osborn, 1960; Weatherwax & Benoit, 1957).

Research Setting

The study was conducted on the school grounds. Phase 1 was carried out in one classroom office and due to loss of electricity, Phase 2 was conducted in a different classroom office.

For Phase 1, the room was 20 feet by 14 feet and the slides were projected onto a screen 13 feet from the projector. The room for Phase 2 was 12 feet by 9 feet and the slides were projected onto a screen 11 feet from the projector. The audio portion was set at a normal voice level. Each subject was seated at a table in a chair next to the researcher.

Administration of the Study

Two researchers administered the slide-tape presentations. While the researcher escorted each subject to the testing location the following statements were made:

> Hello, (subject's name). My name is (researcher's name).
> We are going to see some pictures and it will be fun.

Once the subject was seated and ready for the first trial the researcher gave the following directions:

> This is a fun game. We are going to see some pictures and hear the words for the pictures at the same time. When the pictures end, I want you to do your best and tell me all the pictures you can remember. Ready?

Before the next trial the researcher gave the following directions:

> We're going to do this four more times. You will see the same pictures but in a different order. Remember, when the pictures end, I want you to do your best to tell me all the pictures you can remember. Ready?

The researcher cued the subject before each of the remaining trials by asking, "Ready?"

Each subject was given up to two minutes, after each trial, to verbally recall as many items as possible. If during the recall period the subject stopped responding, the researcher waited ten seconds and then asked, "Do you remember any more words or pictures?" or "Do you remember anything else?" These verbal prompts were given again, a maximum of two more times, and then the researcher ended the trial. Verbal praise was given following each recall session. The following statements were randomly used by the researcher, "Good Job," "Great," "Good remembering," "Good work," and "Good try."

Two researchers conducted the study. Both researchers conducted part of Phase 1 and part of Phase 2 of the study. Interobserver reliability was calculated to determine the consistency of observation between the two researchers. The percent of number of agreements on the recorded recall responses was calculated by dividing the total number of agreements by the total number of agreements plus the total number of disagreements (Huck, Cormier, & Bounds, 1974). In Phase 1, interobserver reliability was calculated on three randomly chosen subjects. The percent of reliability agreement was 100 percent, 100 percent, and 92 percent. Two interobserver reliability checks were made during Phase 2 and agreement was 100 percent for both observations.

Response Recording Instrument

The researchers recorded the subjects' responses. The subjects verbally recalled the items and the researcher wrote down each response on the recording protocal (see Appendix E).

Treatment Conditions

The study was conducted in two phases covering a three week period. During Phase 1, the subjects in Group 1 viewed the five randomly repeated trials on List A (related items). Subjects in Group 2 viewed List B (unrelated items) during the same week. After a one week interval, Phase 2 was conducted. During the third week, the subjects in Group 1 viewed List B (unrelated items) and the subjects in Group 2 were shown List A (related items). All of the presentations were conducted on an individual basis and lasted approximately 20 minutes.

Data Analysis

The dependent variables under investigation included recall, cluster organization, and subjective organization. This section presents an overview of the organization measures which were used to quantify cluster organization and subject organization. The data analysis of recall, cluster organization, and subjective organization is also discussed.

Organization Measures

To measure cluster organization on List A (related items) Bousfield and Bousfield's (1966) Deviation Measure was used to calculate an expected category repetition E(SCR) and obtained category repetition O(SCR) score. The Deviation Measure is presented in detail in Appendix C.

Bousfield and Bousfield's (1966) Deviation Measure was chosen for two reasons. First, based on the critical review of cluster organization measures in Chapter II, the Deviation Measure was an adequate measure of cluster organization. Second, the comparison of the current study to other studies was facilitated because of the widespread use of Bousfield and Bousfield's (1966) Deviation Measure (Gerjouy & Winter, 1970; Gerjouy, Winters, Pullen, & Spitz, 1969; Herriot, 1972; Herriot & Cox, 1971; Palmer, 1974; Perlmutter & Myers, 1979).

To measure subjective organization on List A (related items) and List B (unrelated items) Gorfein, Blair, and Rowland's (1968) bidirectional (E) Measure was used. This (E) Measure allowed an expected value of intertrial repetitions (E) and the obtained value of intertrial repetitions (O) to be calculated. The (E) Measure is presented in detail in Appendix B. Based on the critical review of subjective organization measures in Chapter II, the (E) Measure was considered a useful calculation because allowances for bidirectional repetitions were made. Other subjective organizational formulas could only be used to evaluate unidirectional repetition.

Gorfein, Blair, and Rowland's (1968) (E) Measure was developed to analyze subjective organization using unrelated items. Herriot and Cox (1971) and Perlmutter and Myers (1979), in their research comparing subjective organization and cluster organization using related and unrelated items, used subjective organization measures on both the related and unrelated items. Herriot and Cox (1971) indicated, for example, if subjective organization scores were significant on the related items and the cluster organization scores on the same items were nonsignificant the subjects would have recalled the items sequentially as associates rather than hierarchial as categories. Subjects would have used their own strategies (i.e., subjective organization) rather than using the categories of the items (i.e., cluster organization) to assist in the recall of the related items.

Analysis of Data

Dependent t-tests and Pearson product-moment correlations were used to analyze the dependent variables recall, cluster organization, and subjective organization. Three questions with six null hypotheses were analyzed using dependent t-tests. The effect of types of items (related or unrelated) on the number of items recalled (H1), the effect of rehearsal on the number of items recalled (H2, H3), and the determination of the use of organizational strategies above a chance level (H4, H5, H6) by TMH adolescents were analyzed using dependent t-tests.

Pearson product-moment correlations were used to analyze the fourth question with the last three null hypotheses. The relationship between recall and organizational strategies with related and unrelated items by TMH adolescents was analyzed using Pearson correlations.

The level of significance used in all the analyses was .05, and this level has been commonly used in experimental research (Huck, Cormier, & Bounds, 1974). The .05 level of significance was appropriate to use in the current study as it has also been the level of significance utilized in similar research.

Summary

This study was conducted to examine the effects of the independent variables, types of items (related and unrelated) and rehearsal (number of trials) on the dependent variables, organization (cluster and subjective) and recall using a counterbalanced repeated measures design. Thirty TMH adolescents viewed a slide-tape presentation of 12 related items (List A) and 12 unrelated items (List B). Five random trials with each list of items was given. Cluster organization was measured using Bousfield and Bousfield's (1966) Deviation Measure on the related items (List A). Gorfein, Blair, and Rowland's (1968) (E) Measure was used to calculate subjective organization on the related items (List A) and unrelated items (List B). The number of items recalled was also analyzed.

Overview of Remaining Chapters

The results of the study, including data analysis procedures, analysis of the data, summary of results, and an overview of the final chapter, are presented in Chapter IV. Chapter V includes an overview of the study, a review of related literature, summary of methodology, discussion of findings, observations and limitations, practical implications, and suggestions for further research.

CHAPTER IV

RESULTS

The current research was conducted to investigate the effects of types of items (related and unrelated) and rehearsal (number of trials) on organization (cluster and subjective) and recall by trainable mentally handicapped (TMH) adolescents. A slide-tape presentation of the randomly ordered pictures was shown to the subjects using five trials. The subjects' verbal free recall responses were then recorded by the researchers.

Results of the study are presented in Chapter IV. The chapter includes the data analysis procedures, the analysis of the data, a summary of results, and an overview of the final chapter.

Data Analysis Procedures

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) (Nie, Hull, Jenkins, Steinbrenner, and Bent, 1975). Dependent t-tests were calculated to investigate the first six hypotheses. Pearson product-moment correlations were calculated to investigate the last three hypotheses. A .05 level of significance was used for all statistical analyses.

Statistical Analysis of the Data

The study was conducted to examine the effects of types of items and rehearsal on organizational strategies and recall using an auditory and visual input task with TMH adolescents. The statistical analysis of the data has been divided based on the four general questions which were investigated. First, does the type of item (related or unrelated) affect the number of items recalled by TMH adolescents? Second, do repeated trials (rehearsal) affect the number of items recalled by TMH adolescents? Third, do TMH adolescents organize related and/or unrelated items above a chance level? Fourth, does a relationship exist between the number of items recalled and organizational strategies used with related and unrelated items by TMH adolescents? The four conditions have been expressed as nine null hypotheses.

Effect of Type of Item on Recall

The effect of types of items on the subjects' recall was investigated. One null hypothesis was proposed and questioned whether there will be no significant difference in recall scores between related and unrelated items obtained by TMH adolescents (H1). Dependent t-tests were used to analyze the recall scores of the related and unrelated items. The mean recall scores, standard deviations, t value, and probability level of the related and unrelated items on each of the five trials are presented in Table 8.

Table 8

Recall Scores of Related and Unrelated Items

Trial	Items	Mean	Standard Deviation	t value	p
1	R	5.5	2.2	1.28	0.21
	U	5.0	1.8		
2	R	6.1	2.4	0.35	0.73
	U	6.0	2.1		
3	R	6.8	2.3	1.42	0.17
	U	6.3	2.1		
4	R	6.5	2.4	-0.37	0.31
	U	6.6	2.1		
5	R	7.2	2.4	1.04	0.31
	U	6.9	2.1		

Note. R = related items; U = unrelated items.

No significant differences were found between the number of related and unrelated items recalled on each trial and therefore the null hypothesis (H1) was retained.

The standard deviation and mean recall scores on the related and unrelated items are graphed in Figure 1. The similarities between the recall scores of the related and unrelated items are evident. The mean differences range from 0.1 to 0.7. The effect of rehearsal on recall is discussed further in the following section.

Effect of Number of Trials on Recall

The effect of rehearsal on the number of items recalled by TMH adolescents was investigated. Two null hypotheses were developed. One of the hypotheses stated that there will be no significant difference between the number of related items recalled on each of the five trials by TMH adolescents (H2). There will be no significant difference between the number of unrelated items recalled on each of the five trials by TMH adolescents was the other presented hypothesis (H3). Dependent t-tests were used to analyze the number of related items and unrelated items recalled on each successive trial.

The comparison between trials on recall scores with related items is presented in Table 9. There was a significant difference between the number of items recalled on Trial 1 when compared to Trials 3, 4, and 5. There was also a significant difference between the number of items recalled on Trial 2 when compared to Trials 4 and 5, and Trial 4 when compared to Trial 5.

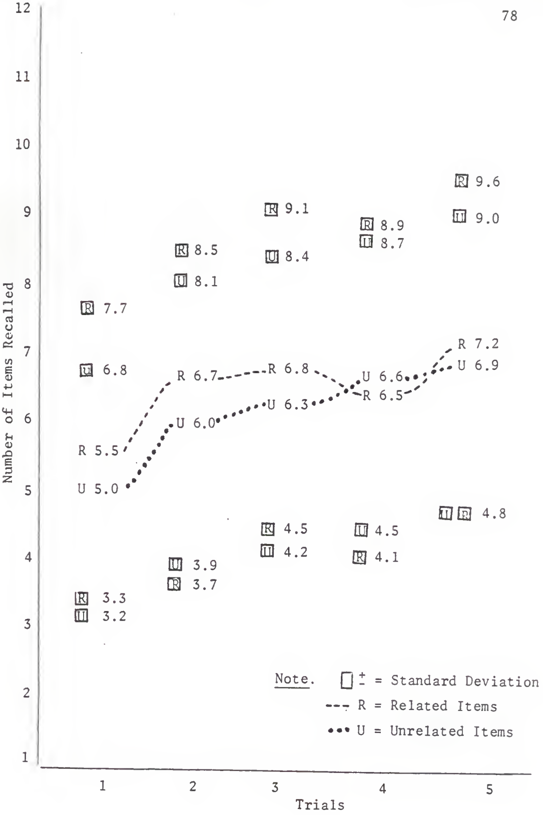


Figure 1

Recall Scores of Related and Unrelated Items

Table 9

Recall of Related Items Compared Between Trials

Variable	Mean	Standard Deviation	t value	p
R1 R2	5.47 6.10	2.21 2.41	-1.81	0.08
R1 R3	5.47 6.80	2.21 2.28	-4.18	0.00*
R1 R4	5.47 6.50	2.21 2.36	-2.64	0.01*
R1 R5	5.47 7.20	2.21 2.36	-4.07	0.00*
R2 R3	6.10 6.80	2.41 2.28	-2.30	0.03*
R2 R4	6.10 6.50	2.41 2.36	-1.08	0.29
R2 R5	6.10 7.20	2.41 2.36	-2.72	0.01*
R3 R4	6.80 6.50	2.28 2.36	+1.36	0.18
R3 R5	6.80 7.20	2.28 2.36	-1.44	0.16
R4 R5	6.50 7.20	2.36 2.36	-3.63	0.00*

Note. R# related items on a particular trial number.

$^{*}p < .05$.

Table 10 presents the comparison between trials on recall scores with unrelated items recalled over trials. There was a significant difference between the number of items recalled on Trial 1 when compared to Trials 3, 4, and 5. There was also a significant difference between the number of items recalled on Trial 2 when compared to Trials 4 and 5.

The significant differences of the mean number of related items recalled over successive trials and the mean number of unrelated items recalled over successive trials are charted in Figure 2 and Figure 3, respectively. Figure 2 and Figure 3 show the effects of rehearsal on recall. For related and unrelated items, significantly more items were recalled on the later trials (e.g., Trials 4 and 5) when compared to any early trial (e.g., Trial 1).

Determination of Above Chance Organization

Whether or not TMH adolescents organize related and/or unrelated items above a chance level was studied. Three null hypotheses were proposed. The first hypothesis proposed that there will be no significant difference between obtained cluster organization scores and chance cluster organization scores on related items by TMH adolescents (H4). The second hypothesis stated that there will be no significant difference between obtained subjective organization scores and chance subjective organization scores on related items by TMH adolescents (H5). There will be no significant difference between obtained subjective organization scores and chance subjective organization

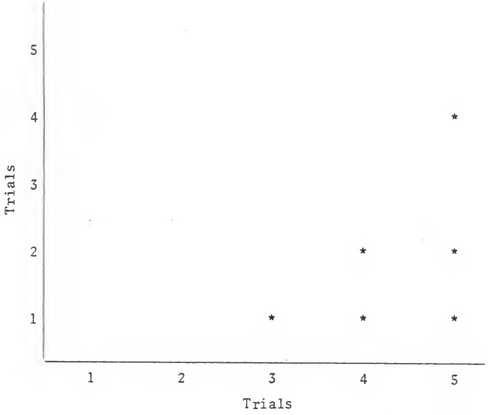
Table 10

Recall of Unrelated Items Compared Between Trials

Variable	Mean	Standard Deviation	t value	p
U1	5.03	1.83	-3.56	0.00*
U2	5.97	2.13		
U1	5.03	1.83	-4.94	0.00*
U3	6.33	2.12		
U1	5.03	1.83	-5.63	0.00*
U4	6.60	2.14		
U1	5.03	1.83	-4.85	0.00*
U5	6.87	2.06		
U2	5.97	2.13	-1.43	0.16
U3	6.33	2.12		
U2	5.97	2.13	-2.57	0.02*
U4	6.60	2.14		
U2	5.97	2.13	-2.25	0.03*
U5	6.87	2.06		
U3	6.33	2.12	-0.87	0.39
U4	6.60	2.14		
U3	6.33	2.12	-1.58	0.13
U5	6.87	2.06		
U4	6.60	2.14	-0.94	0.35
U5	6.87	2.06		

Note. U# unrelated items on a particular trial number.

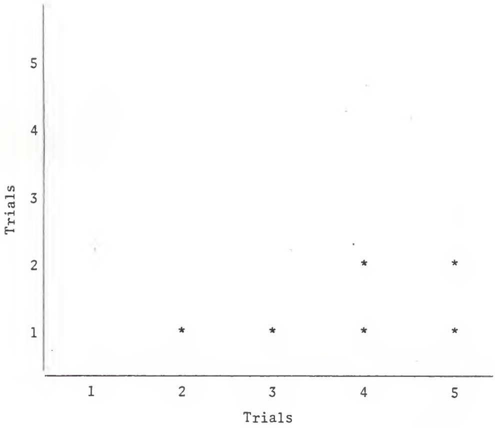
*$p < .05$.



Note. * Significant difference between trials
$p < .05$

Figure 2

Significant Differences Between Related
Items Recalled on Five Trials



Note. * Significant difference between trials
$p < .05$

Figure 3

Significant Differences Between Unrelated Items Recalled on Five Trials scores on unrelated items by TMH adolescents was the third investigated hypothesis (H6). Dependent t-tests were used to analyze the obtained and chance organization scores on the related and unrelated items.

The organizational scores used in the dependent t-tests were calculated based on the cluster organization formula (i.e., Deviation Measure) developed by Bousfield and Bousfield (1966) and the subjective organizational formula (i.e., (E) Measure) presented by Gorfein, Blair, and Rowland (1968). The formulas have been previously discussed in Chapters II and III and are presented in detail in Appendix C.

The results of the statistical analysis of the obtained and chance cluster organization scores on the related items are presented in Table 11. Significant differences between the obtained and chance cluster organization scores were found on two trials (Trials 3 and 4). The difference between the obtained and chance cluster organization scores on Trial 2 approached statistical significance because the probability was .06 and the level of significance was tested at .05. On two trials (Trials 1 and 5) nonsignificant differences were shown between the obtained and chance scores. The null hypothesis (H4) was rejected because the subjects used cluster organization above a chance level.

Subjective organization obtained and chance scores on the related items have been analyzed and are presented in Table 12. To calculate subjective organization scores adjacent trials were paired together (e.g., Trial 1 and 2). The results indicated a

Table 11

Determination of Above Chance Cluster Organization with Related Items

Trials	Variables	Mean	Standard Deviation	t value	p
1	OC	1.5	1.1	1.39	0.18
	CC	1.3	0.6		
2	OC	1.9	1.5	2.00	0.06
	CC	1.5	0.9		
3	OC	2.3	1.3	4.20	0.00*
	CC	1.6	0.7		
4	OC	1.9	1.4	2.25	0.03*
	CC	1.5	0.7		
5	OC	2.0	1.3	1.53	0.14
	CC	1.8	0.7		

Note. OC = obtained cluster organization;
CC = chance cluster organization.
Range of obtained and chance cluster organization scores 0 to 4.0.
*$p < .05$.

Table 12

Determination of Above Chance Subjective Organization with Related Items

Adjacent Trial Pairs	Variable	Mean	Standard Deviation	t value	p
1 & 2	OS	0.47	0.68	-0.39	0.70
	CS	0.51	0.43		
2 & 3	OS	1.03	0.89	1.59	0.12
	CS	0.79	0.37		
3 & 4	OS	1.33	0.84	3.17	0.00*
	CS	0.96	0.38		
4 & 5	OS	1.07	0.14	0.48	0.63
	CS	1.01	0.07		

Note. OS = obtained subjective organization;
CS = chance subjective organization.
Range of obtained and chance subjective organization scores 0 to 4.0.
*$p < .05$.

significant difference between the obtained and chance scores on one paired trial (Trial 3 and 4). Nonsignificant differences were found on the other three paired trials (Trials 1 and 2, 2 and 3, and 4 and 5). The null hypothesis (H5) was rejected because the subjects used subjective organization above a level of chance on one of the paired trials.

The obtained and chance subjective organization scores on the unrelated items were analyzed and are presented in Table 13. No significant differences were revealed between obtained and chance subjective organization scores on the four paired trials (Trial 1 and 2, Trial 2 and 3, Trial 3 and 4, Trial 4 and 5). The subjects did not use subjective organization on unrelated items above a chance level and, therefore, the null hypothesis (H6) was retained.

Relationship Between Recall and Organization

The number of items recalled and organizational strategies used with related and unrelated items by TMH adolescents was investigated. Three null hypotheses were developed to address the question. The first stated hypothesis was that there will be no significant correlation between number of related items recalled and obtained cluster organization scores with TMH adolescents (H7). Second, the following hypothesis was stated. There will be no significant correlation between number of related items recalled and obtained subjective organization scores with TMH adolescents (H8). The last hypothesis investigated stated that there will be no significant

Table 13

Determination of Above Chance Subjective Organization with Unrelated Items

Adjacent Trial Pairs	Variable	Mean	Standard Deviation	t value	*p*
1 & 2	OS	0.47	0.57	-1.03	0.31
	CS	0.58	0.47		
2 & 3	OS	0.90	0.80	1.53	0.14
	CS	0.71	0.49		
3 & 4	OS	0.97	0.16	1.13	0.27
	CS	0.81	0.08		
4 & 5	OS	1.10	0.18	1.13	0.27
	CS	0.90	0.07		

Note. OS = obtained subjective organization;
CS = chance subjective organization.
Range of obtained and chance subjective organization scores 0 to 3.0

correlation between number of unrelated items recalled and obtained subjective organization scores with TMH adolescents (H9). Pearson product-moment correlations were calculated on the recall scores and obtained organization scores to determine whether or not a significant relationship existed between recall and cluster or subjective organization.

The results of the data analysis are presented in Table 14. There was a significant correlation of .76 between the related items recalled and the obtained cluster organization scores. The .76 correlation indicated that as the number of related items recalled increased the obtained cluster organization scores also increased. Based on the significant findings the null hypothesis (H7) was rejected.

There was a significant correlation of .35 between the related items recalled and the obtained subjective organization scores. The .35 correlation indicated that as the number of related items recalled increased the obtained subjective organization scores also increased. The null hypothesis (H8) was rejected based on the significant correlation.

There was a significant correlation of .49 between the unrelated items recalled and the obtained subjective organization scores. The .49 correlation indicated that as the number of unrelated items recalled increased the obtained subjective organization scores also increased. The null hypothesis (H9) was rejected based on the significant findings.

Table 14

Determination of the Relationship
Between Recall and Organization

Variable	Correlation	*P*
RI with OC	0.76	0.00*
RI with OS	0.35	0.03*
UI with OS	0.49	0.00*

Note. RI = related items recalled;
OC = obtained cluster organization scores;
OS = obtained subjective organization scores;
UI = unrelated items recalled.
$^*p < .05$.

Summary

This study was conducted to investigate the effects of types of items (related or unrelated) and rehearsal (number of trials) on organization (cluster and subjective) and recall of a bimodal (visual and auditory) input task with TMH adolescents. Dependent t-tests were calculated to investigate the null hypotheses, H1 through H6, and Pearson product-moment correlations were calculated to investigate the null hypotheses, H7 through H9. The cluster and subjective organization scores used in the dependent t-tests and Pearson product-moment correlations were calculated using Bousfield and Bousfield's (1966) Deviation Measure and Gorfein, Blair, and Rowland's (1968) (E) Measure, respectively.

The statistical analysis revealed both significant and nonsignificant findings. There were no significant differences between recall scores on related and unrelated items over the five trials (H1). There was a significant difference between the number of related items recalled on Trial 1 when compared to Trials 3, 4, and 5, Trial 2 when compared to Trials 4 and 5, and Trial 4 compared to Trial 5 (H2). On the unrelated items, there was a significant difference between the number of items recalled on Trial 1 when compared to Trials 3, 4, and 5, and Trial 2 when compared to Trials 4 and 5 (H3).

On three trials (Trials 2, 3, and 4), there were significant differences between obtained and chance cluster organization scores with related items (H4). There was a significant difference on one paired trial (Trial 3 and 4), between obtained and chance subjective organization scores on the related items (H5). No significant differences were found between obtained and chance subjective organization scores on the paired trials with unrelated items (H6).

Significant correlations were found between the related items recalled and obtained cluster organization scores (H7), related items recalled and obtained subjective organization scores (H8), and unrelated items recalled and obtained subjective organization scores (H9).

Nine null hypotheses were investigated and two were retained and seven were rejected. Based on the analyses, the following conclusions for the subjects in this study have been drawn. Types of items did not affect the subjects' recall and the subjects did not use subjective organization above a chance level on unrelated items. Rehearsal aided the subjects' recall on the related and unrelated items. There was tenuous evidence that among trials on the related items, practice interfered with the subjects' recall. Subjects used cluster organization on related items above a level of chance. Subjects' use of subjective organization on related items was given tenuous support. Over trials, the subjects' recall scores revealed a positive relationship between organizational strategies and number of items recalled.

Overview of Remaining Chapter

Chapter V, the final chapter, includes an overview of the study, a brief review of related literature, summary of methodology, discussion of findings, and observations and limitations. Practical implications and suggestions for further research are also presented.

CHAPTER V

DISCUSSION AND CONCLUSIONS

An overview of the study, a brief review of related literature, summary of methodology, discussion of findings, and observations and limitations of the study are presented in Chapter V. The chapter concludes with practical implications and suggestions for further research.

Overview of the Study

The overview of the study includes the rationale and purpose of the research. A brief review of the related literature and summary of the methodology are also presented.

Rationale

How do individuals learn? This question has long been the foundation for debate, postulation, discussion, and study by behavioral, social science, and educational researchers. Researchers continue to be concerned with the process and transformation of knowledge represented in learning theory. Theories and philosophies such as Associationism, Darwinism, and Gestalt Psychology have given justification to the importance of memory in the learning process (Tarpy & Mayer, 1978).

Memory processing models, such as those advanced by Broadbent (1958), Atkinson and Shiffrin (1968), Ellis (1970), and Spitz (1973), have been developed to explain how the memory system works. Organization has been considered one of the major components in memory. Organizational strategies have been used by individuals to help them remember information.

One type of organization used in the memory process has been secondary organization which described an individual's ability to recall information based on characteristics of the presented information (Moely, 1977). Secondary organization has been and will continue to be important to researchers and practitioners in the field of learning because input can be manipulated. For example, information can be presented in categories rather than presented randomly. Investigating how individuals use secondary organization strategies will allow manipulation and organization of input to facilitate efficient learning.

Secondary organization has been divided into cluster organization and subjective organization. Cluster organization refers to the grouping of related items freely recalled from a random ordered presentation governed by relationships among the items (Bousfield, 1953). Subjective organization refers to an individual's tendency to freely recall unrelated items in the same order on successive recall trials when the information has been randomly presented (Tulving, 1962).

The emphasis on organizational strategies has been of major concern to researchers investigating memory and learning (Bousfield & Bousfield, 1966; Ellis, 1963; Spitz, 1963). Deficits in memory skills have been shown in mentally handicapped subjects (Ellis, 1963; Gerjuoy, Winters, Pullen, & Spitz, 1969; Riegel & Taylor, 1974; Spitz, 1966). The concern of individuals working with mentally handicapped individuals has been to structure the environment to facilitate learning and aid memory development (Cegelka & Prehm, 1982; Mercer & Snell, 1977; Snell, 1978). Through systematic investigations into the use of organizational strategies (e.g., secondary organization) by mentally handicapped individuals, suggestions can be provided to assist in learning and recall.

Organizational strategies and recall have been researched with normal and mentally handicapped subjects. Research has been conducted on a limited basis with trainable mentally handicapped (TMH) individuals. The current study was conducted to investigate organizational strategies and recall with TMH individuals.

Purpose

The purpose of the study was to examine the effects of types of items (related and unrelated pictures) and rehearsal (five trials) on organization (cluster and subjective) and recall with TMH adolescents. Four questions were researched. First, does the type of item (related or unrelated) affect the number of items recalled by TMH adolescents? Second, does rehearsal (repeated trials) affect the number of items recalled by TMH adolescents? Third, do

TMH adolescents organize related and/or unrelated items above a chance level? Fourth, does a relationship exist between the number of items recalled and organizational strategies used with related and unrelated items by TMH adolescents?

Nine null hypotheses addressed the four questions under investigation.

Effect of Types of Items on Recall

H1: There will be no significant difference in recall scores between related and unrelated items by TMH adolescents.

Effect of Number of Trials on Recall

H2: There will be no significant difference between the number of related items recalled on each of the five trials by TMH adolescents.

H3: There will be no significant difference between the number of unrelated items recalled on each of the five trials by TMH adolescents.

Determination of Above Chance Organization

H4: There will be no significant difference between obtained and chance cluster organization scores on related items by TMH adolescents.

H5: There will be no significant difference between obtained and chance subjective organization scores on related items by TMH adolescents.

H6: There will be no significant difference between obtained and chance subjective organization scores on unrelated items by TMH adolescents.

Relationship Between Recall and Organization

H7: There will be no significant correlation between number of related items recalled and obtained cluster organization scores with TMH adolescents.

H8: There will be no significant correlation between number of related items recalled and obtained subjective organization scores with TMH adolescents.

H9: There will be no significant correlation between number of unrelated items recalled and obtained subjective organization scores with TMH adolescents.

Brief Review of Related Literature

To thoroughly understand and evaluate organization and recall research it is important to be familiar with the statistical techniques developed to measure organizational strategies. The literature overview begins with a brief description of the formulas developed to quantify organizational strategies used in free recall. The summary of reviewed organization and recall studies is then presented.

Organizational Measurement

Formulas have been developed to measure cluster organization and subjective organization. An example of how cluster and subjective organization have been investigated follows. First, a list of items is randomly presented to the subject over a specified number of trials. Second, the subject is asked to freely recall the items after each trial. Third, the organizational formulas are used to quantify the patterns in the information freely recalled by the subject.

Cluster organization measures. Five different formulas which measure cluster organization were developed. Bousfield (1953), Robinson (1966), Bousfield and Bousfield (1966), Frankel and Cole (1971), and Roenker, Thompson, and Brown (1971) developed these formulas.

Bousfield (1953) and Robinson (1966) developed two of the earliest cluster organization measures. Bousfield's (1953) ratio of repetition (RR) was a ratio between the number of repetitions of items recalled from a given category and the total number of repetitions possible. Robinson (1966) modified the RR measure and labeled the new formula the item-clustering index (ICI). Clustering by chance could not be considered using either the RR or ICI measure.

Bousfield and Bousfield (1966) developed the Deviation Measure which expanded the RR measure to enable the comparison of an obtained cluster organization score to a chance cluster organization score. The development of the Deviation Measure allowed a more thorough investigation into cluster organization strategies. The most frequently used formula in the cluster organization studies reviewed has been the Deviation Measure.

Frankel and Cole (1971) and Roenker, Thompson, and Brown (1971) developed cluster organization ratio measures, Z measure and adjusted ratio of clustering measure (ARC), respectively. Ratio measures allowed cluster organization scores on lists of different lengths to be compared.

Subjective organization measures. Three formulas which measure subjective organization were developed by Tulving (1962), Bousfield and Bousfield (1966), and Gorfein, Blair, and Rowland (1968). Tulving's (1962) subjective organization measure (SO) was a ratio score of obtained subjective organization to maximum subjective organization. The SO formula could be considered to parallel Bousfield's (1953) RR measure, as both compared an obtained organization score to a maximum organization score.

Modifications were made to the SO measure by Bousfield and Bousfield (1966) and Gorfein et al. (1968). Bousfield and Bousfield (1966) developed the intertrial repetition measure (ITR) which enabled the comparison to be made between an obtained subjective organization score and a chance subjective organization score. The expected value of intertrial repetitions (E) Measure developed by Gorfein et al. (1968) permitted a bidirectional calculation of the ITR measure. Pairs of items could now be compared without regard to order within the item pair. Anderson and Watts (1969) suggested the bidirectional measure, (E) Measure, was a more sensitive measure than the unidirectional ITR measure and therefore a better measure to use.

In the subjective organization studies reviewed Bousfield and Bousfield's (1966) ITR measure was used more frequently even though the (E) Measure of Gorfein et al. (1968) may have been a more sensitive measure. Three explanations may be offered. First, Bousfield and Bousfield's (1966) formulas may have been more widely known based on the extensive published research conducted by the two researchers.

Second, the ITR measure was published in a well known journal and the (E) Measure was published in a lesser known journal. Third, Bousfield and Bousfield were more well known in organizational research than Gorfein, Blair, and Rowland.

Organization and Recall Studies

Researchers have investigated how individuals learn by studying individuals' abilities to use organizational strategies and recall information. Based on an extensive review of related literature, data based studies on cluster organization and recall, subjective organization and recall, and cluster organization, subjective organization, and recall were reviewed. The independent variables were lists of unrelated or related pictures or objects and the dependent variables were verbal free recall and cluster organization or subjective organization.

The studies presented were conducted over a 22 year period and used a variety of subjects. Subjects ranged in age from 2 to 23 years. Researchers compared normal subjects and mentally handicapped subjects on the dependent variables free recall and cluster organization or subjective organization. Comparisons were also made between different types of mentally handicapped subjects on the same dependent variables.

The reviewed studies have shown various results. The following discussion is divided into results in the areas of recall, cluster organization, and subjective organization.

Results in recall. Researchers found no differences in the number of items recalled among different types of mentally handicapped subjects (Gerjuoy & Winters, 1970; Osborn, 1960; Weatherwax & Benoit, 1957). Conflicting results were reported by researchers when normal and mentally handicapped subjects were compared on recall. Palmer's (1974) recall results suggested there were no differences between mentally handicapped and normal subjects. Gerjuoy et al. (1969) and Riegel and Taylor (1974) found normal subjects recalled significantly more than mentally handicapped subjects. Gerjuoy et al. (1969), Gerjuoy and Winters (1970), Herriot and Cox (1971), Mende (1974), and Palmer (1974) found recall significantly increased over trials for all subjects.

Results in cluster organization. Results of studies investigating the use of cluster organization indicated that cluster organization occurred at a significant level with a wide age range ability levels of mentally handicapped and normal subjects (Gerjuoy & Winters, 1970; Gerjuoy et al., 1969; Herriot & Cox, 1971; Palmer, 1974; Perlmutter & Myers, 1979; Riegel and Taylor, 1974; Weatherwax and Benoit, 1957). Herriot and Cox (1971) and Riegel and Taylor (1974) reported a positive correlation between recall and cluster organization.

Results in subjective organization. The reviewed subjective organization studies had mixed results. Herriot and Cox (1971) and Mende (1974) found subjective organization was used by adolescent and adult mentally handicapped subjects. Perlmutter and Myers (1979) reported subjective organization was not used significantly by preschool children. Additional results from Mende's (1974) research indicated a nonsignificant use of subjective organization by mentally handicapped children. Mende (1974) found a positive correlation between recall and subjective organization with the mentally handicapped adolescents. A nonsignificant correlation between recall and subjective organization was shown in Herriot and Cox's (1971) study.

Summary of Methodology

This study was conducted to examine the effects of the independent variables, types of items (related and unrelated) and rehearsal (number of trials) on the dependent variables, organization (cluster and subjective) and recall using a counterbalanced repeated measures design. Thirty TMH adolescents, ages 15 to 21 years, served as the subjects.

Two lists were developed that included 12 related and 12 unrelated items and are presented in Table 5. The items were high frequency words from Thorndike and Lorge's (1944) frequency tables. The 12 related items were from three categories. Each list was randomized for five different trial presentations and are presented in Table 6 and Table 7.

A slide-tape presentation was developed using pictures of the items from the Peabody Picture Vocabulary Test, Forms M and L (Dunn & Dunn, 1981). Each list of items was presented auditorily and visually at four second intervals. Five random trials were used.

The subjects were randomly divided into two groups. One group viewed the related items first, followed one week later by the presentation of unrelated items. The order of presentation was reversed for the other group, who were shown the unrelated items followed one week later by the related items.

Two researchers conducted the study. The same directions were read to all the subjects and are presented in Chapter III. The slide-tape presentation was shown individually to each subject. After each of the five trials the researcher recorded the items the subjects verbally recalled. At the end of the presentation each subject was asked, "What helped you remember the pictures?" This question was asked to find out why the subjects thought they were remembering the items and if they were aware of their own organizational strategies.

Recall and organization (cluster and subjective) were the analyzed dependent variables. Recall scores were the number of items recalled on each trial. Cluster and subjective organization scores were calculated using Bousfield and Bousfield's (1966) Deviation Measure and Gorfein, Blair, and Rowland's (1968) (E) Measure, respectively.

Discussion of Findings

The current research findings are compared and contrasted to the reviewed studies. The discussion is divided into five areas including comparison of subjects, comparison of recall, comparison of cluster organization, comparison of subjective organization, and the comparison of the recall and organization relationship.

Comparison of Subjects

The comparison of subjects is divided into two areas. The areas are descriptive comparisons and performance.

Descriptive comparison. The 30 TMH subjects had a mean age of 18 years, 3 months, and a mean I.Q. of 39. TMH adolescents were chosen to participate in the study based on the limited recall and organization research with this population. The majority of reviewed research was conducted with subjects ranging in mean I.Q. from 50 to 110 and mean age of 2 to 20 years (Becker & Morrison, 1978; Gerjuoy & Winters, 1970; Gerjuoy et al., 1969; Mende, 1974; Osborn, 1960; Palmer, 1974; Perlmutter & Myers, 1979; Riegel & Taylor, 1974; Weatherwax & Benoit, 1957). Herriot (1972) conducted a study using lower level subjects with a mean I.Q. of 20 and a mean age of 24 years. The research by Herriot and Cox (1971) used subjects closest in ability and age to the current study. The subjects had a mean I.Q. of 40 and a mean age of 13 years.

Recall and organizational strategies using a bimodal (auditory and visual) presentation of related and unrelated items with TMH adolescents had not been investigated. Using TMH adolescents allowed a comparison to be made along a hierarchy of age and ability as well as allowing a developmental comparison to subjects in other studies. Analysis of previous research indicated that a wide age range and ability level of subjects used cluster organization (Gerjuoy & Winters, 1970; Gerjuoy et al., 1969; Herriot & Cox, 1971; Palmer, 1974; Perlmutter & Myers, 1979; Riegel & Taylor, 1974; Weatherwax & Benoit, 1957). Rehearsal significantly increased recall by mentally handicapped subjects (Gerjuoy & Winters, 1970; Gerjuoy et al., 1969; Mende, 1974; Palmer, 1974). Mende (1974) found that adolescent EMH subjects (mean age 14 years) used subjective organization significantly and EMH children (mean age 9 years) did not use subjective organization at a significant level. Herriot and Cox (1971) found that TMH adolescents (mean age 13 years) did not use subjective organization significantly. The age and ability level of the subjects in the current study fit in the developmental continuum between Mende's (1974) subjects and Herriot and Cox's (1971) subjects.

Performance. The researchers carefully observed the subjects' behaviors and concluded that the subjects appeared to enjoy participating in the study. The subjects' perceived enjoyment may have been due to the extra attention they received (e.g., taking home permission slips, being taken out of class to participate, individual attention from the researchers). The majority of subjects appeared motivated to try their best on all the trials. Verbal praise and encouragement seemed to facilitate the subjects' motivation.

Other researchers in the field have discussed the phenomenon of spontaneous rehearsal by mentally handicapped subjects (Herriot & Cox, 1971; Mende, 1974). For example, the subjects are told to look at a series of pictures and to listen to the names of the pictures. The subject then verbally repeats the names of the pictures as they are presented. This verbal repetition is called spontaneous rehearsal because the subject was not asked or cued to verbally practice.

In the current study, 57 percent of the subjects used spontaneous rehearsal. The subjects either verbalized or used sign language and verbalized to name the items when the slide-tape presentation was given.

According to some researchers, short-term memory deficits of the mentally handicapped have been the result of inadequate use of rehearsal strategies (Brown, 1974; Ellis, 1970; Kellas, Ashcroft, & Johnson, 1973). Therefore, it is of interest to note the subjects' spontaneous use of rehearsal. The spontaneous rehearsal may have been the result of previous learning situations where the subjects have been encouraged to participate (e.g., verbally rehearse) or the subjects' desire to be actively involved in the task.

Comparison of Recall

The analysis of the recall data indicated that the number of items recalled was not significantly different between the two types of items (related and unrelated). The related and unrelated items had both used high frequency words from the Thorndike and Lorge (1944) frequency tables. The relationship (i.e., high frequency words) between the items may be a reason no significant difference in recall was found based on item type.

Results conflicting with the current study were reported by Perlmutter and Myers (1979). A significant difference was found in the mean number of items recalled between related and unrelated items with normal preschool subjects (ages 2 to 4 years). The differences in results between the two studies may be attributable to the age (2 to 4 years vs. 15 to 21 years) and ability differences (normal vs. TMH) of the subjects or to the different number of type of items or trials used in the two studies. Perlmutter and Myers (1979) used nine objects and three trials and the current study used 12 pictures and five trials.

Recall scores over the five trials on related items were investigated. The investigation revealed that the number of related items recalled increased over Trials 1, 2, 3, and 5 and fewer items were recalled on Trial 4 than Trial 3. Comparisons were made between each recall trial and there was a significant increase in recall between Trial 1 and Trials 3, 4, and 5. There was also a significant increase between Trial 2 and Trials 4 and 5, and between Trial 4 and Trial 5.

The analysis of the related items recall data suggested that the subjects recalled fewer items on the early trials (Trials 1 and 2) and then reached a plateau on the later trials (Trials 3, 4, and 5). A review of the results also indicated that more practice (repeated trials) on the randomly presented related items, resulted in decreased recall scores. The outcome of decreased recall scores was consistent with Herriot and Cox's (1971) findings that adult mentally handicapped subjects' recall scores decreased with more practice.

Recall scores over five trials on unrelated items were investigated. The number of items recalled increased over the five trials. Comparisons between each recall trial showed significant increases in recall scores between Trial 1 and Trials 2, 3, 4, and 5 and between Trial 2 and Trials 4 and 5.

The analysis of the recall scores with unrelated items suggested that practice increased recall. These results are consistent with the findings of Gerjuoy and Winters (1970), Gerjuoy et al. (1969), Mende (1974), and Palmer (1974) who found that practice aided recall. The review of the recall data in the current study also suggested that while recall increased over all trials the amount of recall reached a plateau on the later trials (Trials 4 and 5).

Comparison of Cluster Organization

Obtained and chance cluster organization scores on the related items were measured by the researcher. The analysis of the cluster organization data indicated a significant difference between obtained and chance cluster organization on three of the five trials (Trials 2, 3, and 4) and the highest obtained cluster score was on Trial 3. Repetition (repeated trials) increased the amount of obtained cluster organization through Trial 3 and reached a plateau on Trials 4 and 5.

There was a nonsignificant difference between obtained and chance organization on Trial 1 and Trial 5. Lack of exposure to the items may have been a reason for the nonsignificant finding on Trial 1. The results of a nonsignificant difference between the obtained anc chance cluster organization scores on Trial 5 suggested that repetition (practice) of the same items, randomly presented, interfered with the subjects' use of cluster organization.

An analysis of the data showed that the subjects used cluster organization. The results from the current study were consistent with earlier findings reported in the literature that mentally chance subjective organization scores revealed nonsignificant differences between obtained and chance subjective organization scores on all the paired trials (Trials 1 and 2, Trials 2 and 3, Trials 3 and 4, and Trials 4 and 5).

The analysis on the eight paired trials with related and unrelated items found the differences between obtained and chance subjective organization scores to be nonsignificant on seven of the paired trials. The results of the current study were consistent with the developmental hierarchy of individuals' usage of subjective organization as presented in the reviewed literature. Mende (1974) found that subjective organization occurred above chance with mildly mentally handicapped adolescents (mean age 14 years) but did not occur above chance with mildly mentally handicapped children (mean age 9 years). Subjective organization above a chance level was nonsignificant with normal preschool children (mean ages 3 and 4 years) (Perlmutter & Myers, 1979) and moderately mentally handicapped children (mean ages 12 years) (Herriot & Cox, 1971).

Comparison of the Recall and Organization Relationship

Significant correlations were found between the three compared recall scores and obtained organization scores. The significant correlations were between related items and obtained cluster organization (.76), related items and obtained subjective organization (.35), and unrelated items and obtained subjective organization (.49). Recall scores and obtained organizational scores increased over trials with the related and unrelated items.

The results of the present study were consistent with earlier findings of significant relationships between recall and cluster organization. Herriot and Cox (1971) and Riegel and Taylor (1974) also found cluster organization correlated with recall with mentally handicapped subjects.

Previous research findings on subjective organization and recall have been mixed. Subjective organization and recall were significantly correlated with mildly mentally handicapped adolescents, but was not significantly correlated with mildly mentally handicapped children (Mende, 1974). A nonsignificant correlation between recall and subjective organization was found with moderately mentally handicapped adults by Herriot and Cox (1971). The current findings have added more inconsistencies to recall and subjective organization research. When the results of the current study were placed on a developmental continuum with other subjective organization research the developmental hierarchy was disrupted. The inconsistent findings in subjective organization and recall research could possibly be attributed to the use of different subjective organization formulas. Gorfein, Blair, and Rowland's (E) Measure would indicate more subjective organization than Bousfield and Bousfield's (1966) ITR measure. Mende's (1974) study and the current study used the (E) Measure and Herriot and Cox (1971) used the ITR measure.

The results of the data analysis have been presented in this section. Descriptive information (observations and limitations) is discussed in the following section.

Observations and Limitations

At the end of each session, the subjects were informally asked, "What helped you remember the pictures?" The question was asked to find out if the subjects were aware of organizational strategies and to find out why the subjects thought they were remembering the information.

The subjects gave four different responses to the question. The first response was to name the items from the slide-tape presentation and this answer was given by 20 percent of the subjects. For example, the subject said, "horse, train, foot, eye" when asked the question. Not answering the question was the second response and 33 percent of the subjects did not respond to the question. The third response was a reference to the head or body and was given by 33 percent of the subjects. The fourth response, given by 14 percent of the subjects, included phrases such as "by listening," "looking at the pictures," and "thinking."

The different types of responses indicated the subjects' perception of their own memory processing system. Over half (53 percent) of the subjects apparently did not understand the question which indicated they were unaware of what helped them remember information. Some of the subjects (33 percent) believed that something happened to them which caused them to remember the information. For example, the subject had a brain and by having a brain memory occurred. Another group of subjects (14 percent) believed that they actively did something that enabled them to remember the information (e.g., listening, looking, thinking).

Answers related to organizational strategies or rehearsal were never given by the subjects. The subjects apparently were not aware or were unable to verbalize that grouping information together aided recall or that practice aided recall.

The practical implications in the next section were developed based on the data analysis, question responses, and the inherent limitations of the study. Limiting factors included the following. The subjects' previous learning experiences and familiarity with the items may have influenced the results. Two researchers administering the study may have affected the subjects' responses. The modality of presentation may have also influenced the outcome of the study. The subjects in the study were adolescents who attended the same school and this affects the generalizability of the study.

Practical Implications

Researchers and practitioners need to cooperate to develop techniques which will facilitate learning and memory by mentally handicapped individuals. Based on the current research, when considered with the related reviewed literature, practical implications for instruction with TMH adolescents are presented. The practical implications are presented in four areas including rehearsal and recall, cluster organization and recall, subjective organization and recall, and organization correlated with recall.

Rehearsal and Recall

The analysis of the recall data supported previous research data that rehearsal increases recall. The importance of practice and repetition for TMH students to acquire and remember information has been reiterated in methodology textbooks for moderately mentally handicapped students (Cegelka & Prehm, 1982; Payne, Polloway, Smith, & Payne, 1981).

Teachers of TMH students can facilitate learning through the use of practice and repetition. Commercial materials are available which emphasize practice and rehearsal. Instructional games, self-correcting materials, drill worksheets, and computer assisted drill and practice can be used by teachers to incorporate rehearsal into instruction. Teaching strategies, such as direct instruction, small group instruction, peer tutoring, and precision teaching can also be used with an emphasis on rehearsal.

Practice materials should not be assigned randomly without forethought. Teachers should monitor practice sessions to ensure efficient learning.

Cluster Organization and Recall

The research findings of the current study were consistent with previous findings that the use of categories (i.e., clustering) facilitated recall. For the classroom teacher, presenting information in groups or categories may aid TMH students' recall of information.

Subjective Organization and Recall

Based on the results of this study, there does not appear to be evidence to suggest that subjective organization strategies are useful in aiding recall by TMH adolescents. Teachers of TMH students should not expect their students to develop subjective organization strategies as a technique to aid recall.

Correlation of Organization and Recall

The researcher found organizational strategies were significantly correlated with recall. The TMH subjects' organizational scores increased as their recall scores increased. While organization and recall are correlated this does not indicate a cause and effect relationship. Practitioners should remember that working directly on organizational strategies alone may not cause an improvement in recall by TMH students.

The results from the current study and other related research suggests that organization and repetition can facilitate recall and learning. Organization (e.g., grouping of items) and repetition in materials and presentation of information may be considered when making instructional decisions for TMH students. It is not recommended that repetition and organizational strategies be taught only for the purpose of developing repetition and organization skills. Direct instruction of organizational strategies should use information that is practical and useful for TMH students.

Suggestions for Further Research

The current research was conducted to provide additional information in learning and memory research. The purpose of the study was to examine the effects of types of items (related and unrelated) and rehearsal (number of trials) on organization (cluster and subjective) and recall by TMH adolescents. Recommendations for further research are suggested based on this investigation.

A replication of this study should be done with TMH junior high, elementary, and preschool aged subjects. The replication study would provide organization and recall information on TMH subjects of a wider age range. The information could be used to compare junior high, elementary, and preschool aged TMH subjects to subjects in previous research along the developmental continuum of organizational strategies and rehearsal. Practical implications for instruction could also be offered based on the outcome of the research.

Research should be conducted to investigate the TMH subjects' perceived knowledge about grouping or organizing information. For example, a similar study to the current research could be conducted and after the repeated trials the subjects could be asked to group the items and explain why they grouped the items in a particular manner. This information should provide information about whether or not TMH students are aware of organizational strategies being used in instruction.

Research should be carried out with TMH subjects to investigate their use of organizational strategies over a long period of time, handicapped subjects used cluster organization to aid recall (Gerjuoy & Winters, 1970; Gerjuoy et al., 1969; Palmer, 1974; Weatherwax & Benoit, 1957). The subjects who participated in the earlier research ranged in mean age from 12 to 22 years and mean I.Q. from 50 to 65. Pictures and objects (12 to 20 items) were presented to the subjects in the earlier studies using five or six trials.

Comparison of Subjective Organization

Obtained and chance subjective organization scores were examined on the related and unrelated items. Obtained subjective organization scores increased over the first three paired trials (Trials 1 and 2, Trials 2 and 3, and Trials 3 and 4) and decreased on the last paired trial (Trial 4 and 5) on the related items. There was a significant difference between obtained and chance subjective organization scores on one paired trial (Trial 3 and 4). Nonsignificant differences were found on the other paired trials with related items. There was tenuous evidence that repetition aided TMH subjects' use of subjective organization on related items based on the one significant finding. In relation to subjective organization, the optimum level of practice was reached on the paired Trial 3 and 4 and then practice interfered with the subjects' use of subjective organization on the last paired trial (Trial 4 and 5).

On the unrelated items the obtained subjective organization scores increased over all paired trials (Trials 1 and 2, Trials 2 and 3, Trials 3 and 4, Trials 4 and 5). An analysis of the obtained and such as a month or a year. Students' organization and recall skills could be assessed periodically over a period of time that begins as the student is learning a skill and continues until the student has mastered the skill.

The question, "How do individuals learn?" will continue to be asked by researchers and practitioners interested in learning and memory. As future research is conducted the results should be interpreted in light of previous knowledge to enable a systematic development of a base of information that will aid in facilitating learning for mentally handicapped individuals.

APPENDIX A

TRAINABLE MENTALLY HANDICAPPED CRITERIA

Trainable Mentally Handicapped--one who is moderately or severely impaired in intellectual and adaptive behavior and whose development reflects a reduced rate of learning. The measured intelligence of a trainable mentally handicapped student generally falls between three (3) and five (5) standard deviations below the mean and assessed adaptive behavior falls below age and cultural expectations.

Criteria for Eligibility

a. The measured level of intellectual functioning, as determined by performance on an individual test of intelligence, falls between three (3) and five (5) standard deviations below the mean. The standard error of measurement may be considered in individual cases. The profile of intellectual functioning shows consistent sub-average performance in a majority of areas evaluated.

b. The assessed level of adaptive behavior is below age and cultural expectations.

c. Sub-average performance on a standardized measure of academic achievement is demonstrated.

APPENDIX B

MEASURES OF CLUSTER ORGANIZATION AND SUBJECTIVE ORGANIZATION

A. Cluster Organization Measures

1. RR measure (Bousfield, 1953)

   RR = ratio of repetition

   $RR = r/N-1$

   N = total number of words recalled
   r = number of repetitions observed

2. ICI measure (Robinson, 1966)

   ICI = item-clustering index

   $ICI = r/c(WC-1)$

   r = total number of repetitions occurring in recall
   c = number of categories represented by the words recalled
   Wc = number of items per category in the stimulus list

3. Deviation Measure (Bousfield & Bousfield, 1966)

   a) E(SCR) = expected stimulus category repetition

   $E(SCR) = \{(m_1{}^2 + . . . + m_k{}^2/n\} - 1$

   m = number of items in a given category
   n = number of items recalled

   b) O(SCR) = obtained stimulus category repetition

   $O(SCR) = 0_1 + . . . + 0_k$

   0 = obtained repetitions in a given category

4. Z score measure (Frankel & Cole, 1971)

   Z = Z score cluster organization measure

   $Z = O_r - M_r / \sqrt{V_r}$

   M_r = mean number of runs
   V_r = variance for the number of runs
   O_r = observed number of runs

5. ARC measure (Roenker, Thompson, & Brown, 1971)

   ARC = adjusted ratio of clustering

   $ARC = R - E(R)/\max R - E(R)$

   R = total number of observed category repetitions (i.e., the number of times a category item follows an item from the same category)
   maxR = maximum possible number of category repetitions
   E(R) = expected (chance) number of category repetitions

B. Subjective Organization Measures

1. SO measure (Tulving, 1962)

   SO = subjective organization

   $SO = \sum_{i,j} n_{ij} \log n_{ij} / \sum_{i} n_i \log n_{ij}$

   n_{ij} = numerical value of the cell in the i^{th} row and the j^{th} column
   n_i = the marginal total of the i^{th} row

2. Intertrial Repetition Measure (Bousfield & Bousfield, 1966)

   a) E(ITR) = expected intertrial repetition

      $E(ITR) = \{c(c-1)\}/hk$

      c = number of items common to two successive recall trials (trials t, t + 1)
      h = number of items recalled on trial t
      k = number of items recalled on trial t + 1

b) O(ITR) = obtained intertrial repetition

$O(ITR) = O_1 + \ldots + O_k$

O(ITR) = number of bigrams common to successive trials

3. (E) Measure (Gorfein, Blair, & Rowland, 1968)

a) (E) = expected value of intertrial repetitions

$E = \{2c(c-1)\}/hk$

c = number of items common to two successive recall trials (trials t, t + 1)
h = number of items recalled on trial t
k = number of items recalled on trial t + 1

b) (O) = obtained value of intertrial repetition

$(O) = O_1 + \ldots + O_k$

(O) = number of bidirectional bigrams common to successive trials

APPENDIX C

EXAMPLES: ORGANIZATION FORMULAS

Cluster Organization Formula

Given below is an example of Bousfield and Bousfield's (1966) Deviation Measure used to calculate cluster organization in the current study. To calculate the obtained cluster organization score the Obtained Stimulus Category Repetition, O(SCR), formula was used. The Expected Stimulus Category Repetition, E(SCR), was used to calculate the amount of cluster organization expected by chance.

Example:

Related items in four categories (birds, countries, fabric, and musical instruments) have been presented to the subject. The subject freely recalled, after one trial, the items in the following order.

1. oriole
2. trumpet
3. piano
4. flute
5. Mexico
6. clarinet
7. Russia
8. England
9. Italy
10. Sweden
11. hawk
12. parrot
13. dacron
14. harp
15. silk
16. rayon

1. $O(SCR) = O_1 + O_2 + O_3 + O_4$

   O = obtained (pairs or "clusters" in each category are calculated)

$O_1 = 1$, birds (hawk, parrot)
$O_2 = 3$, countries (Russia, England, Italy, Sweden)
$O_3 = 1$, fabric (silk, rayon)
$O_4 = 2$, musical instruments (trumpet, piano, flute)

$1 + 3 + 1 + 2 = 7$ O(SCR)

2. $E(SCR) = \{m_1^2 + m_2^2 + m_3^2 + m_4^2)/n\} - 1$

   m = categories
   n = total number of items recalled

   $m_1 = 3$, birds (oriole, hawk, parrot)
   $m_2 = 5$, countries (Mexico, Russia, England, Italy, Sweden)
   $m_3 = 3$, fabrics (dacron, silk, rayon)
   $m_4 = 5$, musical instruments (trumpet, piano, flute, clarinet, harp)

   $\{(3^2 + 5^2 + 3^2 + 5^2)/16\} = 1 = 3.25$ E(SCR)

The results indicated that the subject's obtained cluster organization score, O(SCR) was 7 and the cluster organization score expected by chance, E(SCR) was 3.25. The subject used cluster organization above a chance level.

Subjective Organization Formula

Given below is an example of Gorfein, Blair, and Rowland's (1968) (E) Measure used to calculate subjective organization in the current study. To calculate the obtained subjective organization score the Obtained Value of Intertrial Repetition (O) was used. The Expected Value of Intertrial Repetition (E) was used to calculate the amount of subjective organization expected by chance.

Example:

The same unrelated items have been presented randomly to the subject over two trials. Using free recall, the subject recalled the items, in the following order.

Trial 1	Trial 2
1. table	1. table
2. baby	2. coat
3. house	3. dog
4. king	4. arm
5. rose	5. paper
6. coat	6. hammer
7. dog	7. house
8. arm	8. baby
9. car	9. cloud
10. paper	
11. apple	
12. hammer	

1. (O) measure
   O = bigrams common to successive trials

   (house, baby), (coat, dog), (dog, arm)
   (O) = 3

2. (E) measure
   $E = \{2c(c - 1)\}/hk$

   c = number of items common to two successive recall trials
   h = number of items recalled on Trial 1
   k = number of items recalled on Trial 2

   $h = 12$ $\qquad k = 9$ $\qquad c = 8$

   $2 \times 8(8 - 1)/12 \times 9 = 1.09$ (E)

The results indicated that the subject's obtained subjective organization score (O) was 3 and the subjective organization expected by chance (E) was 1.09. The subject used subjective organization above a chance level.

APPENDIX D

PARENT AND STUDENT INFORMED CONSENT

I, Alice Tesch, am a doctoral candidate in the Department of Special Education at the University of Florida. I would like the participation of your child in a study I am conducting.

This study involves showing a slide-tape presentation and asking the students to tell what they remember. Two different 20-minute slide-tape presentations will be shown on two separate occasions. It is hoped that by finding out about the information the students remember that teachers can be aided in giving instructions and presenting materials that will help students learn.

The information obtained will be kept confidential to the extent provided by law. There is no risk or discomfort expected, and there will be no monetary compensation. You have the right to withdraw consent for your child to participate in the project at any time without prejudice.

If you have any questions about this study, please contact me at work (392-5874) or home (375-7928). I will be happy to discuss it with you.

I have read and understand the procedures described above, and agree to allow my child ______________________________ to participate in the project, and I have received a copy of this description.

____ ____________________
parent or guardian date

____ ____________________
student date

____ ____________________
witness date

____ ____________________
Principal Investigator date
Alice Tesch, G315 Norman Hall, University of Florida
Gainesville, Florida 32611 (392-5874)

APPENDIX E

RESPONSE PROTOCOL

Date:
Subject # Birthdate CA IQ M/F

List A B Group 1 2

Trial	1	2	3	4	5
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Verbal Praise:
What helped you remember the pictures?

Comments:

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BIOGRAPHICAL SKETCH

The author, Alice Ann Tesch, was born in California on May 5, 1954. She attended public schools in California and Virginia. In high school she began working with exceptional children. Her interest in special education led her from Mills College in California to Florida State University where she graduated in 1976 with a B.S. in special education.

During the five years that Ms. Tesch was a teacher of trainable mentally handicapped students, she also obtained her M.Ed. in Special Education from the University of North Florida. Ms. Tesch has served as an adjunct instructor at Flagler College and as the educational consultant for an adult group home for mentally handicapped residents.

While in the doctoral program at the University of Florida, Ms. Tesch taught undergraduate and graduate special education courses and supervised student interns. She also was the educational diagnostician for the Multidisciplinary Diagnostic and Training Program.

Her participation in professional organizations has extended to local and state offices in the Council for Exceptional Children. She has given numerous presentations at local, state, and national conventions. Ms. Tesch plans to continue her work in the field of special education through college teaching, participating in professional organizations, consulting, and writing.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Stuart E Schwartz

Stuart E. Schwartz, Chairman
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robt F. Algozzine

Robert F. Algozzine
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Catherine Morsink
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Cary L. Reichard
Associate Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Edward C. Turner

Edward C. Turner
Assistant Professor of Instructional
Leadership and Support

This dissertation was submitted to the Graduate Faculty of the Department of Special Education in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1984

Dean for Graduate Studies and
Research